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REPORT
OF THE
SIMLA IMPROVEMENT COMMITTEE,
1914.



SIMLA:
GOVERNMENT CENTRAL BRANCH PRESS.
1914.

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Report of the Simla Improvement Committee, 1914.

INTRODUCTORY.

1. The Simla Improvement Committee, 1914, was constituted under the orders of the Government of India contained in their letter no. 161, dated the 26th September 1913, from the Government of India, Education Department, to the Secretary to the Government of the Punjab, Boards and Committees Department, on the following lines :—

1. A President with a casting vote to be nominated by the Government of India.
2. The Sanitary Commissioner with the Government of India.
3. An officer in the Finance Department of the Government of India to be nominated by the Government of India.
4. An officer in the Public Works Department to be nominated by the Government of India.
5. The Sanitary Commissioner with the Punjab Government.
6. The Deputy Commissioner, Simla.
7. An officer to be nominated by the Punjab Government.
8. A representative of the tax-payers of Simla.

The functions of the present Committee were thus defined by the Government of India. "The first duty of this Committee would be to recommend measures necessary to place the sanitary condition of Simla on a satisfactory basis. It would also be instructed to indicate other improvements of definite necessity and urgency and to prepare estimates or revised estimates of the cost of the various measures recommended. The primary object of the Government of India in suggesting this Committee is to wind up past transactions and to secure that immediate needs shall be efficiently met and it should be understood that they cannot support proposals for outlay on mere additions to the amenities and ordinary conveniences of the place." The appointment and constitution of the Committee were approved by His Honour the Lieutenant-Governor of the Punjab, and the following representatives were subsequently appointed.

President :—The HON'BLE MR. L. C. PORTER, C.I.E., I.C.S.

Members :—The HON'BLE SURGEON GENERAL SIR C. P. LUKIS, K.C.S.I., M.D., F.R.C.S., K.H.S., I.M.S. (in place of the HON'BLE MAJOR J. C. ROBERTSON, C.I.E., I.M.S., who was originally appointed but who proceeded on duty to Aden after the first meeting).

The HON'BLE MR. M. NETHERSOLE, C.S.I.

The HON'BLE MR. R. A. MANT, I.C.S.

F. W. JOHNSTON, Esq., C.S.I., C.I.E., I.C.S.

J. F. CONNOLLY, Esq., I.C.S.

MAJOR E. L. PERRY, I.M.S.

E. CLARKE, Esq.

MAJOR R. A. NEEDHAM, I.M.S., undertook the duties of Secretary.

2. In a further communication dated the 30th May 1914, the questions of the acquisition and conservation of the Chair catchment area, of the extension of the Simla water works, and of the abandonment of the Mahasu orchards were referred to the Committee, which was also directed to investigate the question of the adequacy of the rates charged for electrical energy in connection with the financial aspect of the various schemes under consideration.

3. During the month of May various papers on measures recommended as necessary to place the sanitary condition of Simla on a satisfactory basis were circulated to members, and the Committee met for the first time on Thursday, June the 4th, and decided that they would take up items in the following order :—

- (i) The water-supply of Simla as a whole.
- (ii) The system of sanitation and sewage disposal.
- (iii) Schemes and proposals for improvements of bazaars.
- (iv) The proper sanitation and control of the areas included in the proposed extension of the municipal limits.
- (v) General improvements.
- (vi) Food supplies.
- (vii) Special legislation to be made applicable to Simla.
- (viii) A review of the financial position of the municipality and a consideration of the rates charged for electricity.

A notice was issued inviting the public to forward suggestions or ideas for the sanitary improvement of Simla or to give oral evidence, and the Simla House Proprietors and Trades Associations and a number of gentlemen representative of the European and Indian communities and long resident in Simla were also invited to give evidence.

4. We have considered this evidence and also examined various sanitary and engineering experts. We have also made local inspections in connection with every scheme of importance which we now recommend for the consideration of Government. We propose to deal in this report with the questions before us in the order indicated above.

I.—WATER SUPPLY.

(i) *Old Catchment area.*

5. The Simla water is obtained from the streams on the areas on the south side of the Mahasu slopes, known as the upper and lower catchment areas, from their position on the hill side. The water from the upper catchment area flows by gravitation to the Dhali filters and thence to the Sanjauli reservoir. The water from the lower catchment area flows by gravitation to the Cherot nullah pumping station where it is filtered and after filtration is pumped to the level of the main road near the toll bar and from thence it flows by gravitation to the Sanjauli reservoir. This catchment area was acquired at various periods in 1871, 1892 and 1899 from the Rana of Koti and handed over to the Simla Municipality. The hill sides are well wooded and forest operations are conducted under the Punjab Forest Department. The revenues from the portion of the area acquired in 1871 are divided equally between the Rana of Koti and the municipality. In the other portions compensation for loss of revenue from forest operations was paid at the time of acquisition. Orchards were established in the area in the early eighties by the Punjab Government as a nursery for young plants and fruit trees to supply the Punjab and North-West Frontier Province and to encourage fruit growing in the hills. The profits derived therefrom by the municipality averaged Rs. 584 per annum over the years 1906—1911. The number of orchards has been added to from time to time and there are now seven with a combined acreage of 65½ acres.

6. There are no human habitations in the catchment area except those necessitated by the forest operations, the orchard staff and the municipal staff required to supervise the pipe lines and Seog reservoir. This latter staff consists of about 20 men whose presence is essential and it is under close sanitary supervision. The staff employed in the forests and orchards is not under municipal control and during certain seasons of the year it is much augmented by numerous coolies who enter the catchment area to cut grass, to collect brushwood, and to carry out felling operations. These men cannot be satisfactorily

supervised and have frequently been observed defiling the catchment streams. On numerous occasions the Sanitary Commissioner of the Punjab, the Health Officer, Simla, and the Engineer, Water Works and Drainage, Simla Municipality, have reported that their presence in the catchment area is a source of danger and representations have been made by the Municipal Committee. These have been met by the reply that no deviation can be permitted from the working plan prepared by the Forest Department in 1887. The question of the removal of the orchards on sanitary grounds was definitely raised in 1911, when at the instance of the Simla Municipal Committee the Punjab Government was moved to sanction their abolition.

7. A Committee with Colonel Bamber as President was appointed in 1912 to consider the question. This Committee reported that every endeavour should be made to prevent any pollution of the water-supply and to this end they recommended that the orchards in the area should be abolished. They were, however, satisfied that pollution was likely to be caused to a greater extent by the staff and coolies employed on forest operations, who considerably outnumber those employed in and about the orchards. They recommended that the work in the forest should be reduced to the minimum required for its preservation, by which means the total number of persons employed in the area would be reduced to 10 or 12. His Honour the Lieutenant-Governor (Sir Louis Dane) considered that so long as the preservation of the forests was a necessary adjunct to the continued existence of the catchment area a large staff would be required in the forests, and that the small additional staff required for the orchards could make no appreciable difference. He was unable to endorse the recommendation of the Orchards Committee that the orchards should be entirely abolished, nor was he in favour of restricting the forest operations.

8. We have inspected the orchards and the upper and lower catchment areas. We agree with Sir Louis Dane, that it would not be logical to abolish the orchards and to allow the forest operations to continue. We consider, however, that any question of revenue must be subordinated to sanitary considerations; and we are satisfied that no system of sanitary control for the fluctuating numbers of coolies who enter the area at various seasons of the year can prove satisfactory. We therefore recommend that the orchards should be abolished and the forest operations reduced to the minimum requisite for the preservation of the hill slopes for catchment purposes. We consider that the catchment area should be maintained entirely for the purpose of supplying pure water and not with the object of producing revenue.

9. The old catchment area was acquired from the Rana of Koti in 1871. The conditions of acquisition are explained in a letter dated the 13th June 1887, from the Junior Secretary to the Government of the Punjab, to the Commissioner and Superintendent, Delhi Division. A copy of this letter will be found in Appendix 7. In view of the conditions of acquisition we consider it clear that the Rana of Koti is entitled only to the share of profits arising out of such forest operations as the Municipal Committee may think fit to undertake and is not entitled to any compensation if the area is managed, in accordance with the original intentions of the Punjab Government, with a view to the conservation of the water supply alone and not in order to produce forest income. The Municipal Committee itself will be the greatest loser and we estimate the loss from the cessation of forest operations and sale of timber to be about Rs. 26,000 per annum. We have provided for this loss in our financial forecast.

(ii) Chair Catchment area.

10. A Joint Committee was appointed in September 1913 at the suggestion

1. Letter from the Government of the Punjab, no. 10-G.S., dated the 15th May 1914, and enclosures, viz:—

(a) Letter from the Sanitary Commissioner, Punjab, to the Government of the Punjab, no. 2268, dated the 27th March 1914.

(b) Report of the Chair Catchment Area Committee, with annexures.

(c) Note on the draft report of 25th and 27th February 1914.

(d) Amended report of the Chair Catchment Area Committee.

2. Letter to the Government of the Punjab, no. 182, dated the 9th October 1913.

of the Government of India under the Presidency of Mr. Fenton (now Sir M. Fenton) to consider the question of the acquisition of the Chair Catchment Area. This Committee was unable to arrive at a unanimous finding and the

question of the necessity for acquisition has, therefore, been referred to us for consideration.

11. We have visited Chair and inspected the catchment area, a map of which will be found in Volume II of this report. We have considered the opinions of the scientific members of the Committee, the Hon'ble Sir Pardey Lukis, whose views are recorded in appendix 3, and Major E. L. Perry, Officiating Sanitary Commissioner, Punjab, who has contributed a note on the outbreak of cholera in the Kotgarh sub-tehsil of the Simla district with special reference to the danger which may arise from a similar outbreak at Chair. A note containing a "General description of the catchment area from which Chair water-supply is derived" has also been contributed by Major R. A. Needham. We consider that no useful purpose will be served by entering into any further controversy on the comparatively unimportant question as to whether the source of the water-supply is from surface springs or deep-seated springs, with their origin in the snowy ranges. Whatever its source may be, we are satisfied that the water at Chair is exposed to serious contamination after it leaves the ground and that where it enters the intake pipes in the Pinjaul-ka-nullah and Bithu-ka-nullah, it is grossly polluted and that this pollution is constant. We were convinced that this must be the case from our inspection of the area, which contains 243 houses with a population of 439, and is traversed by the Hindustan-Tibet road with a constant mule traffic. We have, moreover, the evidence of the Health Officer, Simla, who, after a series of exhaustive bacteriological examinations of the water extending over three years, has reported that the water at Chair is 10 to 15 times more impure than the water in the old catchment area, in which, as we have already stated, we consider that the present system of incomplete conservation is unsatisfactory and dangerous. We accept this evidence as to the relative purity of the two sources of supply as conclusive.

12. There remains for discussion the question whether in these conditions a reasonably wholesome and safe supply may be obtained by double filtration through the Jewell filters at Chair and then through slow sand filtration at Dhali, if for financial reasons and owing to possible political difficulties acquisition and conservation are not desirable. The Fenton Committee considered that a reasonably safe water could be obtained by adopting this method of double filtration. We think that the cost of acquisition which is estimated at three and a half lakhs is a minor consideration in a matter of such vital importance as the provision of a pure water-supply. The land belongs to the Raja of Keonthal, and we are assured by the Superintendent, Hill States, that the political difficulties are not insurmountable. We agree with the opinion of Sir Thomas Barclay quoted by Sir Pardey Lukis that "filtration at the best must be regarded as an exceedingly thin line of defence, not to be depended upon as a safeguard against highly polluted waters" such as the Chair source of supply. We agree further with Sir Pardey Lukis that for this reason a system of double filtration would not be a sufficient safeguard for Simla in the event of an outbreak of cholera in the Chair Catchment area; a disaster which there is nothing whatever to prevent unless the area is conserved. The results that might follow, owing to the custom observed by the hill people of burying cholera corpses in or near streams, are described in Major Perry's paper. Moreover, in arriving at this conclusion the Fenton Committee apparently contemplated that the filtration system at Chair would be efficacious and efficiently supervised. It is in our opinion impossible to secure the efficient supervision of a filtration system 13 miles distant from Simla, a question which we further discuss in paragraph 16. The unsatisfactory nature of the recorded tests of the water from the Jewell filter installation is described in paragraph 17 and we were much impressed with the extent to which the efficacy of this filter depends on the efficiency of the human agency employed, and the accuracy with which prescribed tests are applied, the neglect of any one of which may lead to the influx of polluted water into the supply pipes. There is also a further difficulty in the fact that the water-supply to Mahasu, to His Excellency's residence, The Retreat, and to Mashobra, does not pass through the sand filter at Dhali and consequently would be distributed to the consumers at these places after passing through the single filtration system at Chair which is too far distant for efficient supervision and which up to the present has been declared unsatisfactory.

13. We are therefore of opinion that a system of double filtration is not a sufficient safeguard against quite possible dangers and that the water should reach the intake pipes in as pure a state as is possible. In order to secure this end, we consider that it is necessary to acquire and conserve the area.

14. Owing to the fact that the Hindustan-Tibet road runs through the catchment area, a completely satisfactory system of conservation cannot be carried out. We have considered whether the surface drainage of the road, where it passes through the catchment area, and of the hill side above it, can be diverted and discharged into ravines outside the area. In this case it would not be necessary to acquire the upper portion. We have come to the conclusion that the cost of the project, which would amount to about $1\frac{1}{2}$ lakhs, is not commensurate with the advantage to be derived, and that the whole area must be acquired. The mule stage at Golu above the road should be removed outside the catchment area, either to Kufri or Fagu. The road within the catchment area should be metalled and a sufficient conservancy staff appointed to patrol it. Arrangements should also be made to remove and trench animal and human excreta. We further consider that the whole catchment area as well as both sides of the Hindustan-Tibet road, within the area, should be efficiently fenced. This fencing should take the form of reinforced concrete uprights, with three lines of wire. The cost of these proposals is detailed below :—

	Rs.
Acquisition of land and houses, including 15 per cent for compulsory acquisition	3,45,000
Compensation to the Raja of Keonthal for loss of revenue from an area of 102 acres above the road (being capitalised value of grass)	1,000
Cost of fencing with reinforced concrete uprights	27,000
Total	<u>3,73,000,</u>

or say 4 lakhs as an outside estimate.

In addition an annual payment of Rs. 895 must be made to the Raja of Keonthal, as compensation for loss of revenue.

(iii) The adequacy of the through mains.

15. The 1904 Water Works Committee recommended that the water from Chair should be carried to Sanjauli in a new main, laid for the purpose, and an estimate for this main was included in the scheme for the extension of the water works. In the course of construction, however, the main bringing the water from Chair was diverted at No. 17 stream and connected with the 5 and 6 inch mains of the upper gravitation supply, carrying the water from the Seog reservoir and the streams on the upper line. The object of this was to save the cost of a new main from 17 stream to Dhali and it was proposed to convey the water by a by-pass round the Dhali filters and connect with the 6 and 8 inch mains from the toll bar to Sanjauli. Objections have been raised to this scheme on the ground of the anomaly of allowing a water filtered at Chair to be conveyed through the pipes which ordinarily convey the unfiltered water in the 5 and 6 inch mains from the Seog reservoir to Dhali. Moreover these 5 and 6 inch mains from 17 stream could only take the Chair water in the hot weather when the normal supply by gravitation is small. In the monsoon, these two mains are working at their full capacity in order to carry the gravitation supply and, should there be a breakdown at Cherot during the monsoon, it would be impossible to utilise the Chair water at all. For these reasons we are of opinion that the original recommendation should be carried out and that Chair should have its own main through to Dhali and that it should be large enough to carry 400,000 gallons in 24 hours. We recommend that a 6 inch main should be constructed from 17 stream to Dhali, the estimated cost being Rs. 23,000 for a 6 inch Mannesmann tube and Rs. 31,000 for a cast-iron tube.

At present there is a 6 inch main from Dhali and it is connected with the 8 inch main from Cherot at the toll bar from whence these two mains run side by side to Sanjauli. For the reasons given in appendix 9 we consider that

a new main from Dhali to Sanjauli should be laid down, large enough to carry 400,000 gallons in 24 hours. The cost of the new 7 inch main would be for a Mannesman tube Rs. 35,000, for a cast-iron tube Rs. 47,000. If these recommendations are carried out, the whole of the maximum supply available from Chair could be carried in its own through main direct to Sanjauli at all times and at all seasons.

(iv) *Location of filters.*

16. At present the entire water-supply of Simla, excluding the Chair supply, passes through slow sand filter beds. These filter beds have been constructed and located from time to time to meet requirements as the water works have been extended in accordance with the growing demands of Simla. The whole of the upper gravitation supply is sand-filtered at Dhali some three to four miles from Simla. The supply from the lower gravitation line passes through sand filters at or near the Cherot nullah pumping station four miles from Simla and afterwards is pumped 1,300 feet to the level of the Hindustan-Tibet Road. At Chair, a Jewell filter has been installed, capable of filtering 200,000 gallons daily of the water from this area. At present only one filter has been built. The Sanitary Commissioner of the Punjab expressed his doubts as to whether this method of filtration was suitable and reliable. It was decided, however, as the filter had been already ordered that before constructing a battery of Jewell filters of sufficient capacity to filter the whole of the available supply, tests of the filter already installed should be made and that the ultimate decision as to the further extension of this filter should be guided by experience. The results of these tests are discussed below. It will be seen that the filters at Simla, from their scattered location, are extremely difficult to supervise. The only filters at all convenient for the inspecting officer are those at Dhali. Access to the Cherot filter beds is difficult, while the filter at Chair is not only over 13 miles away but involves a descent in the last four miles of some 3,000 feet. Adequate supervision of any filtration system under these conditions is impossible. During our inspections we have been much impressed by the necessity for a regular and strict supervision of the filter beds, and frequent bacteriological examinations of the water. We consider it to be very desirable that the whole of the filter beds should be located in one central spot. Dhali is certainly the most suitable centre and here the whole of the water coming either from Chair, the upper catchment area, or Cherot can be filtered. It will in any case be necessary to extend the existing filters, which although efficient are working at nearly double the usual maximum rates (90 gallons per square foot against the usual rate of 50 gallons); and a policy of concentration should now be adopted. This will necessitate a large increase in the number of filter beds and as the area available is very limited we have considered various alternative proposals in order to give effect to our recommendation as economically as possible. These are—

- (i) the feasibility of a diversion of the road in order to obviate the necessity for cutting away the hill,
- (ii) the possibility of filtering the water from Chair on the top of the hill above the filter beds,
- (iii) the relative cost of sand filters and Jewell filters,
- (iv) the cost of cutting away the hill and levelling the land.

We consider that (iv) is the most feasible and economical plan. We deal below with the merits of sand and Jewell filters, apart from their cost. The existing area at Dhali is 5,400 square feet, and this must be extended to 19,000 square feet calculated to filter 800,000 gallons per diem with one filter closed for cleaning purposes. The estimate for this (details of which are given in appendix 11) amounts to Rs. 85,610.

(v) *Type of filtration.*

17. We have considered the means to be adopted for the efficient purification of the water-supply and have come to the conclusion that the method of slow sand filtration is the best in view of local conditions in Simla. The methods of sterilisation by ozone and by ultra-violet rays are still

in an experimental stage. The same, in some measure, may be said of the mechanical method of filtration so far as hill water is concerned. While this latter method has no doubt given excellent results in various places in America and Europe and in some stations in the plains of India, we have come to the conclusion after considering the working of the present mechanical filter at Chair and also the reports of the experience of other hill stations in India, that it would be unwise to recommend a complete installation of mechanical filters. The recorded tests made by the Health Officer and by the Deputy Sanitary Commissioner at Chair this year have shown that, while under certain conditions excellent results may be obtained, these results vary. These variations may no doubt be attributable to fluctuations in the lime content of the water necessitating change in the quantity of alum to be added, or to insufficient sedimentation; but they are liable to reappear in the absence of the most careful supervision and manipulation of the filters; and it is desirable, particularly in India, to eliminate as far as possible uncertainties due to the human equation.

The method of slow sand filtration is one of proved efficiency and is largely free from these risks. We therefore consider that the system of sand filtration should be maintained and extended at Dhali to meet all requirements. The existing Jewell filter should be maintained at Chair, where, owing to the great head of water, a roughing filter is required for the proper working of the pumps, and the second Jewell filter, which had been ordered before we commenced our proceedings, should also be erected there.

18. The Chair water-supply should be a separate entity, available for use at all times and seasons. Both during and after rain the Jewell filters cannot be used at present owing to their becoming clogged in a couple of hours by the silt brought down by the streams; whilst gravel and stones, brought down by torrents, block up the inlet of the present weir. These defects should be remedied by reconstructing the weir so as to allow free passage for stones and detritus and by providing a larger sedimentation tank for the treatment of the water prior to its entering the Jewell filter. The cost of these proposals is estimated at Rs. 7,000.

19. The pumps at Cherot and at Chair will be worked by electric power. The most economical method of using this power is by working during the day when the load on the cables is light. These pumps will therefore be worked as a rule for 18 hours out of the 24. In order to ensure efficient filtration it is of the first importance that the filter beds should be worked evenly and continuously during the whole 24 hours; and the flow in the mains should be evenly spread over this period in order to avoid air concussion and other mechanical troubles. We consider therefore that balancing tanks, with a capacity of 130,000 and 100,000 gallons respectively, should be installed at the top of the rising mains at Cherot and Chair. The cost of these tanks is estimated at Rs. 28,000.

20. We have estimated the quantity of water which will be required for Simla when the sanitary projects, hereafter detailed, are carried out. Our estimate of the future consumption is as follows :—

	<i>Gallons daily.</i>
Present consumption in a dry hot weather period ...	... 480,000
Additional requirements :—	
(1) Increasing free allowances by 25 per cent ...	... 50,000
(2) Flushing public latrines ...	... 40,000
(3) For sewage connections on private estates ...	... 30,000
(4) Dhobi ghats ...	... 50,000
(5) Flushing surface drains ...	... 10,000
(6) Latrines and water connections in Bazaar houses ...	... 15,000
(7) Mashobra ...	... 25,000
(8) Extensions outside present Municipal limits and to Jakko ...	... 20,000
(9) New sewage extensions (for Pail Depôts) ...	... 10,000
Total ...	780,000

The total supply available may be placed at :—

				<i>Gallons daily.</i>
From upper gravitation lines	...	...	...	40,000
From Cherot pumps	...	...	...	290,000
From reservoirs	...	...	...	50,000
Total				380,000
From Chair	...	...	...	300,000
Total				680,000

Of this amount 50,000 gallons is supplied by the Cherot auxiliary pump, the catchment area of which includes all the pumping station buildings at Cherot and we are of opinion that, if possible, water should no longer be taken from this source. Deducting this therefore from the total available supply, we get a figure of 630,000 gallons per diem, *i.e.*, 100,000 gallons less than the estimated future consumption. The entire scheme will not, however, in all probability be completed for three or four years, and it should be possible within that period to obtain an extra supply of 100,000 gallons from Chair by further extensions in the hydro-electric system. The estimated consumption and available supply will then approximately balance.

(vi) *Extension of water mains.*

21. We agree with the Engineer in charge of the Water and Drainage Works that the following extensions should be made in the water-supply within Simla.

- (1) Extension to Jakko. A pumping plant will be necessary. The estimated cost of this extension is Rs. 40,000.
- (2) Extension of the water-supply beyond Boileauganj.—Estimated cost—Rs. 8,820.
- (3) Extension of the water-supply beyond Kasumpti.—Estimated cost—Rs. 3,369.
- (4) Water-supply to Barari.—Estimated cost—Rs. 7,540.
- (5) Extension in the direction of the cemetery.—Estimated cost—Rs. 3,590.
- (6) Extension to the Nabha Estate—Estimated cost—Rs. 3,000.

For detailed estimates see appendix 13.

(vii) *Water-supply for Mashobra and The Retreat.*

22. These areas cannot be supplied by gravitation from the Dhali filter beds and are dependent on the Chair water main. A small pipe has already been laid, taking off from the Chair main at Charabra. This main is calculated to supply 800 gallons per diem to The Retreat and 20,000 gallons per diem to Mashobra. As this water cannot be filtered at Dhali a sand filter bed should be installed at Charabra on the site occupied by the present keyman's hut below Wildflower Hall. A tank to regulate the flow over the filter bed and a reservoir to distribute the flow to Charabra will also be necessary. These should be situated in juxtaposition with the filter bed at Charabra. The estimated cost of the combined filter bed, tank and distribution reservoir is Rs. 14,000. Detailed estimates are given in appendix 12.

(viii) *Summary.*

23. Our recommendations with regard to the water-supply may be summarised as follows :—

- (1) Abolition of the orchards in the old catchment area, and reduction of the forest operations to the minimum requisite for the

preservation of the hill slopes for catchment purposes. Cessation of the supply from the Cherot auxiliary pump as soon as possible.

- (2) Acquisition and conservation of the entire Chair catchment area, adequate conservancy and metalling of that portion of the Hindustan-Tibet road.
- (3) Provision of a through main from Chair to Dhali, and from Dhali to Sanjauli, sufficient to carry the maximum supply available from Chair at all seasons. Improvements to the intake weir at Chair and enlargement of the sedimentation tank.
- (4) Concentration of filter beds at Dhali; and extension of the existing sand filters to an area of 19,000 square feet.
- (5) Construction of balancing tanks at the summit of the Cherot and Chair rising mains.
- (6) Extension of water-supply to Jakko, Boileauganj, Kasumpti, Barari and the Nabha Estate, and in the direction of the cemetery.
- (7) Installation of a sand filter bed, tank and reservoir at Charabra for the Mashobra water-supply.

24. The estimated cost is as follows:—

- (1) There will be a loss to the Municipality of Rs. 584 per annum owing to the abolition of the orchards and of Rs. 26,000 per annum from the cessation of forest operations. This latter loss, however, would be inevitable to some extent in any case, owing to the electrification of the pumps at Cherot.

			Rs.
(2) Acquisition and fencing of Chair catchment area. (In addition Rs. 895 per annum will be payable to the Keonthal State).			4,00,000
(3) Through mains (Mannesmann)	...	...	58,000
(4) Extension of sand filters at Dhali	...	...	85,610
(5) Balancing tanks for Cherot and Chair	...	...	28,000
(6) Water extensions	...	...	66,319
(7) Filter bed and tanks for Mashobra	...	...	14,000
(8) Improvements to weir at Chair and enlarging sedimentation tanks.			7,000

Total	...	<u>6,58,929</u>
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II.—THE SEWAGE SYSTEM.

25. We have inspected in all its branches the system of sewage disposal in Simla. This system may be described as one of partial water disposal. Pail depôts are placed at convenient distances over the whole of Simla, and the night soil from the latrines of private houses and public latrines is emptied daily into a receptacle, which at fixed periods in the morning and evening is carried to these pail depôts and there disposed of. The depôts are flushed by water and each is connected with a sewage main that conveys the sewage to septic tanks situated (1) at Lal Pani below the main bazaar, (2) below Kasumpti, (3) below Summer Hill, (4) below Kaithu, and (5) below Snowdon. Through these septic tanks the sewage flows at a rate so regulated that the tank empties itself in a period of 16 to 24 hours. Before entering the tanks the sewage is diluted with nullah water estimated to produce a diluted sewage of 10 gallons per head of population served. By its passage through the tank the sewage is partially purified and the resulting effluent is further purified at certain of the septic tanks by being run over the hill side. At Lal Pani the effluent from the tank is run directly into the stream. We have inspected the Lal Pani and Kasumpti septic tanks and while we agree that further means should be adopted for the purification of the effluent we do not consider that the nuisance created is one demanding immediate attention. The time allowed for the passage of the sewage through the septic tanks is not sufficient to ensure the required preliminary purification. In order to lessen the nuisance arising from the smell of the open tanks all the septic tanks might with advantage be covered. This would also assist in the anaerobic purification. We agree with the opinion of Major Clemesha, I.M.S., expressed in his "Sewage Disposal in the Tropics" that the preliminary treatment of a 10 gallon per head sewage should be 36 hours and that the septic tank should be of such a size as to permit of this rate. We agree moreover that the further purification of this effluent is attainable by running it over the hill side in narrow channels, but that, where this is not possible owing to insufficiency of land as at Lal Pani, this natural purification might be accomplished in a small space by providing rough stone filters. These should not be more than 6 feet high. We recommend that experiments be made with such filters. These matters, however, we do not consider to be such as demand immediate attention. The nuisance is limited and the danger to the neighbourhood apparently negligible. To carry out these improvements we think that a sum of Rs. 20,000 should be allotted.

26. The present system of hand carriage and pail depôts for the disposal of sewage in Simla is the cause of many nuisances and dangers. The distances from the latrines to the pail depôts are in some instances great and the sweeper frequently empties his pail into the nearest ravine. Water-flushed latrines exist in various places in Simla. Many of the Government offices have been fitted with latrines of this pattern and experiments have been made with the public latrines in the bazaar with a view of finding out the most suitable type. The types in use, are (1) trough closets, consisting of a common closet with separate seats and an automatic flush system, and (2) a newer type, consisting of separate seats, each with its separate cistern, and intended to be flushed by the user. This latter design leaves little to be desired in the matter of construction and efficiency and we therefore recommend that all new flush latrines should be of this pattern.

27. In our opinion it is of the most urgent importance that the flush Water closets and latrines in private houses and in private compounds. sewage system should be extended as widely as possible throughout the whole of Simla, and we have considered carefully the most practical means of attaining to this ideal in the future. Owing to the structural alterations that would be necessary in the majority of the bungalows of Simla, it is not practicable to require the owners of existing private houses to instal flush water closets, although every facility should be afforded to owners desiring to instal such a system. We are, however, strongly of opinion that, as a condition of their sanction, all new houses should be provided with flush water closets and that every compound in Simla should be provided with a flush

latrine for the servants. We have considered the various alternatives of providing such flush latrines for separate compounds or providing common flush latrines for groups of bungalows and the question whether these latrines should be erected by the municipality or by private owners. The cost of providing such latrines should we think devolve on the owners of property, but the sewage main should be brought within a reasonable distance of each private compound. We think that the municipality should lay down sewage mains to within 100 feet of the latrine of each private compound and that each private owner should provide and bear the cost of the flush latrine and the 100 feet connection. It will be much more satisfactory if each private compound has its own latrine but where several bungalows are closely grouped together and belong to the same owner no objection need be raised to the provision of a common latrine for such groups of houses. The flush latrines provided should be of a standard pattern such as the newest type of latrine erected by the municipality. The night soil of the bungalow will be disposed of either in the ordinary seat or in a compartment designed so as to act as a small receiving depôt. The cost of one seat of a flush latrine is estimated at Rs. 260. The receiving depôt would cost a similar sum. The 100 feet of piping and the necessary joints and water connections are estimated to cost Rs. 235. The cost of a one-seated latrine therefore with its connections is estimated at Rs. 495, of a one-seated latrine with a receiving depôt at about Rs. 700, of a two-seated latrine at Rs. 755, and of a two-seated latrine with a receiving depôt at Rs. 1,015. The design of the present latrine seat, however, is such that we consider it possible that it might be used as a receiving depôt as well as a latrine. These estimates are approximate and will vary with the locality and the nature of the ground, etc. The number of seats necessary for each compound will vary necessarily with the size of the house, the number of occupants and the number of servants, and must be left to the discretion of the Sanitary authorities. The cost we propose to impose on the house owner is not, we think, unreasonable.

28. These proposals will involve a large extension of the sewage mains throughout the whole of Simla. An estimate of the cost of these extensions, amounting to roughly 4 lakhs, has been submitted by the Engineer in charge of the Water and Drainage Works. This estimate may seem large, but the question is in our opinion of such prime importance and the sanitary advantages to be derived so great, that we would place this reform in the forefront of our programme. The detailed estimates are in the records of the Municipal Committee.

29. There are at present in Simla 72 public latrines, situated for the most part in the bazaars. Up to the present nine of these have been converted to the flush pattern. The Engineer in the Water Works and Drainage Department has submitted a proposal for the conversion of 33 latrines at an estimated cost of Rs. 45,000. These 33 are within an easy distance for connection with the sewage mains. We accept this proposal but we think that the principle we have laid down above, that the whole sewage system of Simla should as far as possible be a water flush one, should be adhered to, and that while some of these latrines situated in sparsely inhabited localities can be omitted, the remainder should be converted. We therefore recommend that eighteen of the remaining 30 latrines, the sites of which we have selected, should be made into flush latrines at an estimated cost of Rs. 70,000. A list of these 18 latrines is given in appendix 15.

30. In certain districts of Simla under existing conditions a system of water disposal of sewage is impossible. We recommend strongly the necessary extensions of mains and we agree with the proposal of the 1907 Committee that flush latrines, pail depôts, and new sewage mains should be provided for the districts of Sanjauli and the Convent. A new septic tank will be necessary and will be placed in the ravine between

these areas. The estimated cost of this scheme is Rs. 53,500. The district of Barari beyond the Elysium hill will probably grow considerably in the future. We think that a pail depôt should be erected at Barari village with a new sewage main connecting with the main sewage pipe to the north disposal works. The estimated cost of this project is Rs. 28,000.

There is a large and growing colony situated below Boileauganj which is entirely unprovided with any system of sewage disposal. We recommend the installation of a pail depôt and a new sewage main, a small septic tank being placed in the ravine leading down towards Lal Pani. The estimated cost of this is Rs. 25,000.

The Nabha Estate is a large colony of some 900 people below the Railway Station. A new sewage main from the boundary of the Estate to the Lal Pani main sewage pipe will be necessary. The cost of this is estimated at Rs. 12,000. We also recommend the erection at the expense of the owner of 9 flush latrines at various places throughout the Nabha Estate. The pipe extensions required to bring these within a 100 feet limit will cost Rs. 6,600.

The Bazaar of Kasumpti is at present outside municipal control, but comes within the proposed extension area. It will be necessary to erect a six-seated flush latrine here at a cost of Rs. 1,800.

In paragraph 62 we discuss the question of night soil disposal at Mashobra and Mahasu and recommend that a flush water system for Mashobra Bazaar should be installed at an estimated cost of Rs. 10,000.

31. We have inspected the various types of pail depôts throughout Simla and consider that the newest pattern of pail depôt has great advantages in the matters of cleanliness, freedom from smell and efficient disposal of night soil. There still remain 26 of the old pattern pail depôts. With the large extensions of sewage mains and the provision of flush latrines, it may be found possible to discard and dismantle many of these, but where considered necessary, they should be replaced by the newest type. The estimated cost amounts to Rs. 8,000.

32. As a consequence of the above proposals it will be necessary to provide a large supply of extra water for use in the flush latrines. The quantity of sewage discharged into the mains per diem will also be largely increased. In paragraph 20, in estimating the future consumption of water for sewage in Simla we considered that 80,000 gallons [items 2, 3, and 9] would be available for sewage flushing purposes. It is probable also that the greater part of the 50,000 gallons in item 1 will be devoted to the same purpose. As far as it is possible to judge, we think that these amounts will be fully adequate to meet the demands of all flushing sewage extensions embodied in the above proposals. The water used for flushing pail depôts will be very greatly reduced in amount and this amount will be diverted to flushing the latrines, the night soil of which was formerly flushed at these pail depôts.

33. A note by the Engineer, Water and Sewage Works, on the Simla sewage mains, is printed in appendix 14. The original mains were calculated to carry an amount of fluid much in excess of what was considered likely ever to enter them but no theoretical formulæ exist which, taking into consideration all the various factors involved, can be applied to calculate definitely the amount of fluid which can be carried by existing mains. We consider, that in view of the facts that the mains were designed to carry far more fluid than was likely ever to enter them and that up to the present they have shown no evidence of being too small, the question of their adequacy in future must be determined by actual trial. Such difficulties can only arise by degrees; and must be dealt with, if they occur, by the necessary replacements.

Summary.

34. Our recommendations in the matter of the sewage disposal system may be summarised as follows :—That—

- (1) As a condition of sanction, all new houses built should be provided with a system of flush water closets in the house, and with a flush latrine in the compound.
- (2) All houses and bungalows now existing should be provided with a flush latrine in the compound, the number of seats to be determined by the Health Authorities in accordance with local circumstances and needs.
- (3) All sewage mains should be extended to within 100 feet of such compounds.
- (4) The cost of these extensions should be borne by the municipality.
- (5) The cost of providing the latrines and the 100 feet connection should be borne by the owner of the bungalow.
- (6) All public latrines should as far as possible be converted to the flush system.
- (7) Sewage extensions should be provided for (a) Sanjauli and the Convent, (b) Barari, (c) Boileauganj, and (d) the Nabha Estate, the pipes in the latter being brought within 100 feet of the proposed latrines.
- (8) A sewage system should be provided for Mashobra Bazaar.
- (9) A flush latrine should be provided for Kasumpti Bazaar.
- (10) Pail depôts of the old pattern where considered necessary should be converted to the improved type.
- (11) The effluents from the septic tanks should be more thoroughly purified and experiments should be carried out in this connection, and the septic tanks should be enlarged to provide for a longer time of flow and should be covered in.
- (12) The question of the carrying capacity of the sewage mains should be left for decision in the light of future experience.

35. The estimated cost of these proposals is as follows :—

Sewage Estimates.

	Rs.
1. Extension of sewage mains to bring private latrines within 100 feet of sewage connections ...	4,00,000
2. Conversion of public latrines—	
33 originally proposed ...	45,000
18 others now proposed ...	70,000
3. Extension of sewage mains to—	
(a) Barari ...	28,000
(b) Boileauganj ...	25,000
(c) Sewage system to limit of Nabha Estate	12,000
(d) To bring mains within a 100 feet of proposed new flush latrines in Nabha Estate ...	6,600
(e) Provision of sewage system for Sanjauli and the Convent ...	53,500
4. Sewage system for Mashobra ...	10,000
5. Flush latrine for Kasumpti ...	1,800
6. Conversion of pail depôts to improved type ...	8,000
7. Filters for septic tanks ...	20,000
Total ...	6,79,900

OTHER SANITARY REQUIREMENTS.

36. The sullage drainage system of Simla is in our opinion susceptible of much improvement. The sullage water

Sullage drainage.

from the great majority of the bungalows is not removed from their vicinity, but soaks into the ground either in the immediate neighbourhood of the house or in some neighbouring ravine. The result is that all over Simla there are places in the vicinity of houses and in most of the ravines where sullage water contaminates the ground. Foul smells emanate from these collections, and they afford suitable breeding places for flies and in addition, when the moisture has evaporated, polluted particles are blown about by the wind. We have no doubt that the inhalation of this matter is one of the chief causes of the throat affections which are so common in Simla. We are therefore of the opinion that all places both on the roads, and in the ravines, where sullage water may collect, should be provided with impermeable drains which will carry the sullage away either to the sewers or well beyond the confines of the inhabited area. We have considered the list of roadside drains, nullahs and ravines which in the opinion of the sanitary authorities require attention and we agree that all the works recommended in this list should be carried out. The Combermere nullah in particular needs attention. This is a collection of irregular and rocky nullahs converging into a large ravine running below the nullah. In its present condition it is quite impossible to keep it in a sanitary condition and situated as it is in the heart of Simla, we consider that its efficient drainage, though difficult and expensive, is a matter of urgent necessity. We agree with the Resident Engineer that the only way to treat the ravine and its branch nullahs efficiently is to smooth out the irregularities as far as possible and lay a 9-inch cast iron drain securely fixed in a bed of cement. Thus the whole nullah and its tributaries will be converted into an impermeable drain in which no rubbish sewage or sullage can find a permanent lodgement. The cost of the project is estimated at Rs. 50,000.

We also inspected the termination of the line of catch pits below the main bazaar. The ravines below these are irregular and rocky and are in a state of constant pollution with foul silt and sullage coming from the main bazaar region. We are of opinion that efficient treatment of these ravines should be undertaken at once and that in each a 9-inch cast iron drain should be provided fixed securely in a cement bed. These cast iron drains should be carried as far as possible to the bed of the nullah below where there is usually a sufficient flow of water to carry away any material brought down by the drains. The estimated cost of these drainage recommendations including the Combermere nullah is Rs. 1,60,075. Detailed estimates of these proposals are given in appendix 17.

37. The present system of road side scavenging in Simla in our opinion leaves little to be desired. It is unnecessary to give details but a system of disposal is gradually being developed for the prompt removal of all refuse

Scavenging.

in impermeable receptacles. The refuse thus collected is ultimately disposed of by incineration. There are at present eight small incinerators which are in the main effective and are capable of dealing with the limited amount of refuse brought to them. The working of the large incinerator below the slaughter house is, however, extremely unsatisfactory. The rubbish is let down by a long uncovered chute. This during rain becomes a water channel, thus soaking the rubbish and rendering it incapable of combustion. Further we consider the incinerator itself to be of faulty design. The result is that in the neighbourhood of the incinerator there are great mounds of offensive rubbish 50 feet high fermenting and breeding millions of flies. Moreover even when the incinerator is working under the best conditions with dry rubbish, it emits volumes of dense smoke. It is impossible to obviate this smoke nuisance by any incinerator of the natural draught type. It is essential in the first place that the chute leading down to the incinerator should be covered to protect it from rain. The cost of this is estimated at Rs. 5,000. Secondly, we consider that a natural draught incinerator even of good design will probably not be able to dispose of the large

amount of rubbish daily received and can never do so without nuisance and we recommend the installation, at an estimated cost of Rs. 30,000, of a destructor working by forced draught, preferably of the Horsfall type. The heat generated by the combustion of the refuse will in all probability provide power enough for the working of the forced draught. Further we consider that the following districts should be provided with small incinerators:—in the neighbourhood of the Nabha Estate 2 incinerators, at Barari 1 incinerator, at Mashobra 2 incinerators, at Kasumpti 1 incinerator, at Sanjauli 1 incinerator, a total of seven in all. The cost of these seven incinerators we estimate at Rs. 2,500 each.

The total cost of these proposals is estimated at Rs. 52,500.

38. In 1911 a new small-pox hospital was built below the cart road.

Disinfectors.

At present all the clothing, personal effects, etc., of small-pox patients, which require to be disinfected, must be taken to the large disinfectant at the Tara Devi plague post some 6 miles distant. It is of the utmost importance that articles of this description, which may be highly infectious, should be disinfected at the small-pox hospital. We therefore recommend that a small disinfectant of the Equifex type be placed at the small-pox hospital. A disinfectant should also be available in the bazaar for the use of the Health Officer. The estimated cost of these two disinfectors is Rs. 10,000.

39. The present system of washing clothes in Simla is extremely

Dhobi Ghats.

insanitary. The dhobi ghats are situated in various nullahs. The water in which clothes are washed consists mostly of the natural drainage of the hill sides, contaminated by all the drainage of the houses above. A proposal has been made to establish in a central situation a steam laundry, where all the washing would be done, but we recognise that there are serious objections to such a project. A similar experiment initiated in Darjeeling proved a total failure. Not only did the dhobies refuse to work in the laundry but it was found that the charges, necessary to make the laundry a paying concern, were such that the public refused to pay and we believe that similar results would probably ensue in Simla. We therefore accept the recommendations of a sub-committee which examined the question in 1912 and recommend that new dhobi ghats be built in the following seven places:—

- (1) Shankli, below Koti Rana's house, which would serve Elysium spur and north of Jakko.
- (2) Annandale; the new ghat would be on the east bank of the nullah, fairly high up and would serve Kaithu and Yarrow spurs.
- (3) Summer Hill, below the Railway line and just above Aindri village; this ghat would serve Summer Hill and Boileauganj. This site has the disadvantage of being across the Railway; no other site appears, however, to be suitable.
- (4) Below the Nabha Estate, would serve Chaura Maidan and Tuti Kundi.
- (5) Below the old Distillery and above Sarhan, would serve the bazaar.
- (6) Near Dyer's Brewery, would serve the south side of Jakko.
- (7) Below Ellerslie, would serve Chota Simla.

At each of these sites quarters for the dhobies should be built and a deep verandah provided for ironing and for partial drying. A pipe water supply should be laid on and the washing places designed so as to allow of a clean water and a soapy water tank with a through flow of water and adequate drainage. The total cost of these dhobi ghats is estimated at Rs. 40,000 in all. We suggest that, as an experimental measure, some form of drying apparatus might be installed by the municipality at one of the dhobi ghats.

III.—BAZAAR AREAS. PROPOSALS FOR IMPROVEMENT.

40. The improvement of the bazaar areas in Simla has presented the most difficult problem with which we have had to deal. No control was exercised in the past over the growth of these collections of buildings, which are in great part unfit for human habitation, both on account of their structural defects, and of their overcrowded position. Moreover, no adequate provision has been made to cope with the rapid increase in the Indian population; conditions, already bad, have been gravely aggravated; and it is impossible to enforce rules against overcrowding until accommodation can be provided elsewhere for the displaced population. Insanitary conditions in certain localities rival those in the worst slums in cities in the plains, and constitute a standing menace to the health of the town.

The Improvement Committees which have sat in Simla since 1875 have from time to time, suggested various remedies, which, had they been carried out would have obviated to some extent the present insanitary conditions. The 1898 Committee, as a remedy for overcrowding, suggested that a minimum cubic space for each person living in the bazaar should be enforced, but it is evident that this only affords a partial remedy, unless the displaced population can be accommodated elsewhere.

The 1907 Committee recommended the acquisition and demolition of numerous isolated insanitary houses. Their proposals are detailed in appendix 18 and the action taken on each up to the present is shown. Even if carried out in full, these suggestions would have afforded but a partial remedy.

41. In dealing with the problem, the main objects to be attained are the removal of insanitary buildings, the clearance of obstructive and congested buildings, the prevention of overcrowding and provision elsewhere for the surplus population dishoused. We have inspected the whole of the main bazaars and outlying bazaars and have come to the conclusion that the existing evil must be dealt with gradually on a definite and comprehensive plan. We have selected certain areas which in our opinion press most for sanitary reform. We propose to acquire these areas and to demolish the existing houses; and to rebuild them on modern sanitary principles, with ample provision for air space and light. These houses will provide for a large percentage of the dishoused population, and will also afford a lucrative source of revenue. In the case of the main bazaar, where congestion is most acute, we propose to provide further accommodation down the hill towards Sarohan, Pagli and Dhar villages. A comprehensive scheme for providing accommodation at Dhar for Indian clerks, the majority of whom live in the bazaars and contribute largely to the overcrowding, is a main feature of our proposals, which we now deal with seriatim.

(a) LAKKAR BAZAAR.

42. This bazaar was described by the 1907 Committee as an excrescence on the European quarter, and they recommended that it should be entirely removed and the shop-keepers be given sites in more suitable localities. This Committee also recommended the improvement of the grading of the road leading from the Lakkar bazaar to Elysium. We agree that the present buildings in the Lakkar bazaar are extremely congested and insanitary but we are of opinion that the mere presence of this bazaar which is mainly occupied by carpenters and other unobjectionable traders should not of itself be necessarily an eye-sore or a nuisance to the European population in its vicinity. The bazaar undoubtedly requires radical treatment and we recommend that the whole of it should be acquired and demolished; and that it should be partially rebuilt on a plan relieving congestion and providing ample provision for light and air. The Mall in the direction of Snowdon would then be of uniform width, and the road leading to Elysium could be widened and regraded so as to ease the steep slope at the summit. Certain parts of the bazaar will not be rebuilt, *e.g.*, the two blocks at the back between the upper portion and

Corstorphan's hotel ; the three shops at the east end of the middle portion, and the two upper shops of the lower portion. The main proportion of the displaced population can be accommodated in the rebuilt houses, which can if necessary be of three stories in places. A plan of these proposals is shown in map No. 10. The total cost of acquisition we estimate at Rs. 2,20,108, and the total cost of reconstruction, including the improvements to the road, at Rs. 1,13,000.

(b) KAITHU BAZAAR.

43. The 1907 Committee recommended that this bazaar should be entirely removed. We are unable to agree. A bazaar in this situation is a necessity, but it can be greatly improved. The block of buildings at the entrance to the bazaar should be acquired and demolished. The road from the entrance to the bazaar below the Mythe should be carried straight down to meet the road leading to the Jail, and the open space provided by the removal of the block of buildings planted with trees and flowers. The present flush latrine will require to be removed a little further back. The adoption of this proposal will secure a broad road from the Mythe road to the Annandale road, avoiding any part of the Kaithu bazaar. The material derived from excavating this new road may be usefully employed in broadening the road further down.

The two small insanitary houses at the extreme south end of the bazaar should be demolished and we propose that a two storied building on sanitary lines should be built here to accommodate the people dishoused. The road here will be widened. The cost of acquiring the proposed houses is estimated at Rs. 13,290 and the cost of reconstruction at Rs. 11,510. The proposals are shown on map No. 11.

(c) CHOTA SIMLA.

44. We agree with the 1907 Committee that the four shops at the entrance to the Chota Simla bazaar should be acquired and demolished, and the road widened at this part. The shops should not be rebuilt. The cost of this is estimated at Rs. 15,010. The proposal of the Punjab Government to acquire part of the northern side of the Chota Simla bazaar with a view to extending the Police Station and providing a fire and ambulance station will be a further improvement, and we think that the vacant piece of municipal ground at the entrance to the bazaar should be levelled and planted with shrubs. This bazaar is perhaps not so objectionable as others from a sanitary point of view and these proposals are comparatively modest. Nevertheless a plan of the whole bazaar should be made, and the houses rebuilt and set back as opportunity affords. The proposals are shown on map No. 12.

(d) BOILEAUGANJ BAZAAR.

45. The shops and houses actually abutting on this bazaar do not in our opinion require immediate attention but there are several extremely insanitary blocks below the southern side of the bazaar which should be removed, and rebuilt. We propose that these be acquired and reconstructed on sanitary lines. The cost of acquisition we estimate at Rs. 35,738 and the cost of reconstruction at Rs. 25,883.

(e) THE MAIN BAZAAR.

(1) *The Ladaki Mohalla.*

46. The Ladaki Mohalla is an area below the Main Bazaar, so called from the fact that it has long been the favourite resort of Ladaki coolies. The houses on this area are old, dilapidated and in every sense insanitary and proposals for its improvement have constantly been made. An outbreak of cholera recently occurred here, and twelve men, one of whom had contracted the disease, were discovered living in a room fifteen feet square, with no means of ventilation but the door. The 1907 Improvement Committee considered that the improvement of this area was highly desirable, but that the cost of acquisition, then estimated at Rs. 1,36,000, was prohibitive. They considered that the Ladaki Mohalla was from its situation a very suitable place for the construction of houses or barracks

for coolies, but deprecated the construction of such lines by Government, thus endorsing the view expressed by the Municipal Committee in 1899. Nothing was in consequence, done for the improvement of the Mohalla. In 1912 the Municipal Committee on the recommendation of Captain Needham, the Health Officer, made a grant for the commencement of a scheme of improvement. The general scheme was that sites should be cleared and connected by roads which would pass through the congested and insanitary areas. On the sites thus cleared a model building or buildings were to be erected by the Committee. The remaining insanitary houses were gradually to be acquired and the ground cleared. The sites already made were to be leased or sold to the owners of the demolished buildings or to any others willing to build houses similar to the model built by the Committee. This was to consist of suites of five rooms with a monthly rental of about Rs. 15 a month. It will thus be seen that an endeavour was made to change the residential character of the area and to remove the cooly element, replacing it by a class desirous of occupying houses similar to the model and able to pay the rent. Up to the present, two houses have been acquired and demolished, and four sites, which the Committee have seen, have been cleared at an approximate cost of Rs. 18,000. As yet the Municipal Committee have built no model house, nor have they succeeded in leasing or selling any sites. We have inspected the locality and consider that radical improvement is an urgent necessity. We do not think however that any attempt to change the residential character of the population is likely to succeed. We are proposing to provide adequate accommodation amidst pleasanter surroundings for the clerks residing in the bazaar; and further accommodation for the better classes can be provided on sites along the new road which we propose from Dhar to the High School. An area for the accommodation of the cooly population is a necessity, and no better one than that existing can be selected. The whole of the area is equally bad; any remedy for existing conditions to be effective must be radical, and we consider that the entire area should be acquired and the houses demolished by degrees.

We do not believe that the provision of blocks for coolies, on simple but sanitary lines, should necessarily result in failure. We recommend that a double storied block to accommodate 200 coolies be built on a site indicated on map No. 4 by the letter C. Should this, as we anticipate, prove financially successful, other blocks could be built. The development of the remaining sites opened out by the demolition of existing buildings should be left to the discretion of the authority controlling these operations, who will be in a position to judge the lines on which this area is likely to develop; to locate building sites and to prescribe the types of building; this authority can also determine whether it will be more profitable to build and lease, or to sell the sites. Reconstruction should in any case keep pace with demolition.

The Municipal slaughter house is situated in this Mohalla. The area adjacent to the slaughter house, (A on the map No. 4,) should be reserved entirely for the butcher population. Houses for 20 butchers should be built in this area. The present drying sheds for skins should be removed to the lowest part.

At present, there is no proper accommodation for cattle, sheep and goats awaiting slaughter. They are housed in huts and rooms in the butchers' houses. We propose that a cattle shed should be built in this area on site 4, with accommodation for from 50 to 60 cattle. Butchers should be obliged to house their cattle here, preparatory to slaughter, paying a small daily rent to the Committee.

There is a considerable trade in the hiring of job horses and ponies which are housed in stables scattered throughout the bazaar. Most of these stables are unsuitable for the purpose and are a source of nuisance to the residents of the neighbourhood. We think that all these job horses should be removed from the bazaar and accommodated in a central municipal livery stable, where they would be under sanitary control. An excellent site for these stables (B in map No. 4) is available in this mohalla. The road leading from here up to the cart road could be regraded at an easier slope. Accommodation for about 75 ponies will be necessary. Quarters for syces would be built above the stables.

The necessity for proper quarters for the employés of the Municipality has long been felt. We consider that at site D on map No. 4, a beginning might be made in providing such quarters, a two storied block of quarters being built here.

A water carriage system of sewage with flush latrines will of course be essential to the success of any scheme of improvement.

The estimated cost of these proposals is for acquisition Rs. 2,20,108 and building Rs. 1,13,000.

(2) *The old Butcher Khana area.*

47. This is an area situated in the centre of the bazaar and is in our opinion the most insanitary in Simla. Many of the houses are mere hovels, dark, damp, and quite unfit for human habitation. One row of these houses was condemned by the 1907 Committee and their demolition recommended, but up to the present two houses only have been demolished. Situated as this area is in the heart of Simla we consider it should be dealt with on broad lines as soon as possible. The area is a comparatively large one and its acquisition will be costly, but in view of its position it will certainly be a lucrative source of revenue. We propose that all the houses on the area, as demarcated on the map No. 2, should be acquired and demolished and the whole space cleared. At each side a broad avenue of steps will be made leading from the Ganj road below to the lower bazaar above. On the central portion it is proposed that a Town Hall for the use of the Indian population should be built. A public building of this description is one of the chief needs of Simla and would be immensely appreciated by Indians. No better site could possibly be selected. Round the periphery of the area shops and dwelling houses of suitable design will be erected, with ample air space between each and round the central public buildings, access to which will be obtainable on all four sides by broad lines of granolithic steps. The designs for these proposals are embodied in map No. 2. The estimated cost of acquisition is Rs. 4,00,000, and of reconstruction, including the Town Hall, (the cost of which is estimated at Rs. 86,625), is Rs. 3,41,375.

(3) *Kashmiri Mohalla.*

48. This is an area at the eastern end of the bazaar. The buildings are irregularly placed, many are extremely insanitary and from their position obstruct the free passage of light and air. We propose to acquire and demolish the houses as shewn in map No. 5, and our aim in reconstruction has been to provide through ways of communication, allowing ample access to light and air. The details are sufficiently indicated on the plan. The estimated cost of acquisition is Rs. 45,600, and the total cost of reconstruction is Rs. 29,358.

(4) *Pahari Chakla and Alley No. 2.*

49. These are areas in close proximity to the Mall and the whole district is congested and extremely insanitary. In Alley No. 2, there is a large latrine and pail depôt which from their situation and surroundings are extremely offensive. We propose that a new archway should be built leading from the Mall to the Lower Bazaar. This will require the acquisition and demolition of house No. 58 which is in itself an unsightly and insanitary structure. We consider the area an unsuitable one for the location of a pail depôt which can be closed when a flush latrine is erected here. Plans and section of the proposed archway are given in maps Nos. 6 and 7. The flush latrine may be located either in the through way beneath the arches or on part of the site resulting from the demolition of house No. 58. Certain houses in the Pahari Chakla itself we propose to acquire, and demolish. In some cases the space gained is being left to widen the road, in others it is proposed to reconstruct on sanitary lines. In order to widen the road and make its alignment regular, parts of certain houses would be acquired and the frontage set back to the proposed alignment. These proposals are shown in maps Nos. 6 and 7. The total cost

of acquisition is Rs. 13,555, and the cost of reconstruction is Rs. 10,185. In the same district further to the east there are some rooms built under a roadway belonging to the Patiala State and to Maula Baksh. Many of these are used as dwelling houses, for which purpose they are entirely unfitted. We recommend the demolition of these rooms and that the roadway leading to the middle bazaar should be widened by a retaining wall being built in a parallel line with the roadway above. The cost of acquisition is estimated at Rs. 3,050, and the construction of a retaining wall at Rs. 1,500.

(5) *Alley No. 14.*

50. This is an alley running from the Mall half way towards the lower bazaar. Abutting on the lower bazaar are two dilapidated houses belonging to Hori Lal. They are extremely insanitary. We propose that these two houses should be demolished, and that a new alley way leading from the Mall to the lower bazaar should be made. On the site of the eastern house a three-storied building on a correct alignment with the lower bazaar road will be built. The space remaining on the site of the western shop will not be built on, but a new flush latrine which is required for the neighbourhood will be erected here. This latrine will be within easy reach of the Mall. These proposals are embodied in map No. 8. Adjoining this area behind house No. 95 in the bazaar is a small narrow alley which is almost entirely closed in by the projecting verandah at the back of house No. 95, which we recommend should be removed. The cost of acquisition is estimated at Rs. 13,000 and of reconstruction at Rs. 8,351.

(6) *Middle Bazaar.*

51. The middle bazaar is an irregular road running from east to west through the bazaar. In many places there are collections of small dark and dilapidated buildings, whose demolition is desirable to provide air space and to widen the road. As an example of these we take two of the worst, Nos. 18 and 19, which we consider should be acquired and demolished, the estimated cost being Rs. 3,600. The improvement of the rest of the middle bazaar we would leave to the future. A correct map of the whole area is required, showing the present alignment and the correct situation and condition of every house in it. The desired alignment should be indicated on this map, and all future building operations guided by this. Such a map is under preparation.

(7) *Alley No. 7.*

52. This is one of the numerous alley-ways leading from the Mall to the lower bazaar. We take it as an example of how these alley-ways may be individually treated, with a view to providing through ventilation in the bazaar. This particular alley-way is irregular, many of the houses projecting in various degrees, and it is in direct continuation of the eastern boundary of the old butcherkhana area, where we propose to build a broad line of granolithic steps from the Ganj road to the lower bazaar. By widening No. 7 alley-way to a uniform width of 20 feet we thus obtain a broad line of ventilation from the Ganj road through the lower and middle bazaar area right up to the Mall. We propose then to acquire the houses on the western side of the alley-way, demolishing these and building them on a new alignment, keeping the alley a uniform width of 20 feet from top to bottom. These proposals are shown on map No. 9. The cost of acquisition is estimated at Rs. 44,000 and of reconstruction at Rs. 43,700.

(8) *Alley No. 5 and No. 13.*

53. Leading off from Alley No. 5 on its western side there is a small dark alley-way entirely roofed in by verandahs, which should be removed, in order to give access to numerous latrines in the alley. The estimated cost of

acquisition is Rs. 300. In Alley No. 13 there is a sweeper's shed which should be demolished and the alley-way straightened out by acquiring the piece of adjoining land. The estimated cost of this is Rs. 500. We also recommend the removal of the corner portion of house No. 74 in Alley No. 12 at an estimated cost of Rs. 250.

Summary.

54. The above proposals are not to be regarded as in any way exhaustive. The particular areas with which we have dealt are those that in our opinion most require immediate treatment. These schemes when completed will we are confident greatly improve the general sanitation of the bazaars; but further future action is required in areas now left untouched, and should be based on the experience derived from these operations. A systematic survey of the main bazaar area and also of outlying bazaars is now being undertaken by the Survey of India. On this map complete details of all the bazaar buildings will be furnished. The whole bazaar should be systematically examined, each area, road, and alley-way should be carefully considered, and concrete schemes linking up the whole bazaar should be planned, so that ultimately the whole of the main bazaar may come under systematic treatment. This will be the work of time, and can only be carried out by systematic operations carried out with some continuity of policy.

55. The total cost of all these schemes for bazaar improvements both in the main bazaar and in outlying bazaars is estimated at:—

	Rs.
Cost of acquisition	11,19,801
Cost of reconstruction	7,70,442
	<hr/>
Total Rs.	18,90,243
	<hr/>

Of the cost of reconstruction Rs. 6,43,366 is estimated as reproductive and Rs. 1,27,076 as unproductive. Details are given in Appendix 20.

We have estimated, after carefully considering the different conditions of the various localities, that a revenue of Rs. 60,000 per annum may be expected on the completion of the schemes. From this we have deducted Rs. 10,000 per annum for repairs, etc., leaving a net revenue of Rs. 50,000. That this is a conservative estimate will be seen from the fact that we estimate for a return of under 9 per cent on the cost of reproductive construction, whereas existing Municipal buildings yield a similar return of over 13 per cent. The estimates of cost of acquisition have been framed for us by the Deputy Commissioner, Simla, and are, he informs us, based on actual cases which have stood the test of the Civil Courts. We have however in all cases added 10 per cent to his figure as a margin. If the proposals for amending the law with regard to the acquisition of insanitary properties which we submit in paragraph 80 are carried through, the cost of these proposals will be very largely diminished.

(f) DHAR AND PHAGLI EXTENSION AREA. HOUSING OF INDIAN CLERKS.

56. The question of providing house accommodation for clerks, Indian and European, was specifically referred to the 1907 Committee, and they made various suggestions few of which have been carried out. Apart from all other considerations, the matter is one of the first importance in connection with the question of over-crowding in the bazaars. We have made enquiries with regard to the Indian clerk population, and we find that there are of this class in Simla, 1,435 employés of Government—the great majority of the Government of India—with 4,056 dependents. Of these employés, only 92 are provided with Government quarters. The remainder reside largely in various bazaars, and no fewer than 652, exclusive of dependents, are housed in the main bazaar amidst the insanitary surroundings which we have described. Full details are given in the statement printed as appendix 25. Apart from sanitary considerations, it is obvious that these men can have no proper accommodation for their families; and it is difficult for

them to educate their children, owing to the lack of schools. The Government of India have, in the past, accepted the principle that it is of the greatest importance both in the interests of Government and of the clerks, that Government quarters should be constructed for the latter; as otherwise the grant of increased allowances to clerks must encourage houseowners in Simla to raise their rents, with the result that expenditure incurred by Government must continue to increase. The Government in 1906 set before themselves the aim of constructing quarters sufficient to provide for some $\frac{2}{3}$ of the clerks in the moving offices, and thus practically to ensure a substantial drop in the rents of private houses. Little has been done to attain this end, at any rate in the case of the Indian clerks.

57. We desire to lay stress upon the great importance, from the sanitary point of view, of dealing with this question in a comprehensive manner. In this connection, and with a view to extensions of the main bazaar generally, we have inspected the areas round Dhar village and in the neighbourhood of Phagli and Sarhan villages below the main bazaar. These appear to us eminently suitable for building purposes. The Municipal Committee of late years have been fully alive to the fact that this neighbourhood is very suitable for building extensions; and they have expended considerable sums on the extension of water and sewage works, and the provision of roads in Dhar. They have also proclaimed a portion of the area at Dhar a restricted area under section 193 of the Municipal Act, thus obtaining control over building operations.

We have selected certain areas in Dhar and its vicinity, and also on the slopes between Dhar and Phagli villages, which in our opinion will form excellent sites on which to build Indian clerks' quarters. The total area of these sites is about 90 acres and allowing 6 quarters per acre it will be seen that there will be ample ground for accommodating all the Indian clerks. There are also excellent sites for schools, for recreation grounds and other amenities. We strongly recommend that this land be acquired *en bloc* at the earliest possible opportunity. It is comparatively cheap at present, owing to the difficulty of access. Once this is removed, the property will increase largely in value; and any portion not required for the clerks' housing scheme can be disposed of at an enhanced value, or utilised for further extensions to the main bazaar.

58. In order to open up these areas communications must be improved and it will be necessary to construct a new 10 foot road at an easy gradient from Dhar *via* Phagli and Sarhan villages to the neighbourhood of the Government High School along which other building sites will be available. The areas we have selected as building sites around Dhar and along the proposed Dhar Phagli road are shown on maps Nos. 15 and 16, the former also showing the alignment of the proposed road. This road will be of a very easy gradient throughout and passes directly below Gorton Castle and other Government offices. It will however be at a vertical distance of 800 feet below them, and the direct climb is exceedingly steep, the angle with the horizontal being about 31° or 1 in 1.6. If a zigzag road of 1 in 10 were made up the hill, the distance would be some $1\frac{1}{2}$ miles and the ascent would occupy the best part of an hour. To ensure the success of the scheme it is therefore in our opinion essential that a lift should be provided, from some point on the road to a point near the Government offices. In connection with this scheme we consulted Mr. Meares, the Electrical Adviser to the Government of India, and Mr. Bradley of the firm of G. Cradock & Co. They have thoroughly examined the project from every point of view and have pronounced it to be eminently feasible. Mr. Meares' views and conclusions are given fully in appendix 23. A counterbalance lift, worked by electric power, is proposed as well as a double track. The upper terminal would be on the road below the stable at Gorton Castle at the junction of the Kennedy House road under the steep road running from the fire engine station to the cart road, the lower terminal being on the proposed road to Dhar vertically below the upper point.

By the construction of the new road and the lift the journey from Dhar to the Mall at Gorton Castle will be greatly facilitated.

To link up the end of the proposed road at the Government High School we consider that the present road from the cart road to Sarhan village should be improved and regraded at places.

59. The estimates for the above proposals are as follows :—

	Rs.
Cost of acquiring 89.55 acres in Dhar and along the line of the new Dhar Phagli Road	1,61,000
Cost of construction of the New Road, including the cost of acquisition of the necessary land	20,000
Cost of improving the road from the Cart Road to Sarhan village ...	3,000
Cost of constructing the proposed lift	1,00,000

The annual charges for working the lift including depreciation are estimated at Rs. 11,918 of which Rs. 5,450, the cost of current, is a book transaction by transfer to another account. The lift is primarily intended for clerks and their families, and they and other *bona fide* residents will no doubt be allowed to use it free or for a nominal sum. We think however that some proportion of the working expenses will be realised from others using the lift; as Mr. Meares remarks, the locality at the bottom is an extremely pleasing one.

We have taken Rs. 1,00,000 as an outside estimate for the cost of the lift, but Mr. Meares is of the opinion that it will be possible by certain economies to reduce this price considerably.

We are of opinion that the above proposals provide a feasible and workable scheme for relieving the congestion in the Bara Bazaar as well as for providing quarters for Indian clerks, and that they are of extreme importance in the scheme of sanitary improvement and should be placed in the forefront of works to be carried out.

(g) THE NABHA ESTATE.

60. The Nabha Estate is situated below the railway station, and now forms an extremely crowded insanitary area, owing to the extensive building operations carried out by the late Raja of Nabha. These buildings were erected for the most part without the sanction and in defiance of the prohibitions of the Municipal Committee, and without the slightest consideration of exigencies of space or sanitary requirements. Difficulties inherent in dealing with a ruling chief who has acquired land within municipal limits have prevented until lately the application of any remedy; but we understand that the Municipal Committee has now been empowered to enforce, if necessary, the ordinary municipal law.

The evil however has been done, and from a census taken for us by the Deputy Commissioner, we ascertained that close on 1000 persons, many of them coolies were residing on this limited space of 5 acres. There are practically no sanitary conveniences, and most of the filth and sweepings is probably deposited straight down the hill side. A detailed scheme for the sanitary requirements of the estate has been put before us by the Health Officer, Simla, and will be found in appendix 21. We agree with these proposals.

We would lay down the proposition that, while as in other cases we should provide a pure water-supply, sewage mains and piping to within 100 feet of the latrines, and incinerators, the cost of carrying into effect the remaining proposals, and of removing the insanitary and obstructive buildings enumerated, should be borne by the Durbar.

We have included in our estimates the items noted above. The area in its present condition is a standing menace to the health of Simla, and we trust that procrastinating methods will not be allowed to delay the prompt adoption of adequate remedies.

IV.—SANITATION OF OUTSIDE AREAS OVER WHICH CONTROL HAS BEEN ACQUIRED.

61. The proposals of the 1907 Committee as regards the extension of Simla limits have been before the Government of India for some time. Definite

proposals for the administration of these tracts, including compensation for cession of jurisdiction are now before Government and we have therefore not dealt with the matter, or included the cost in our financial estimates, beyond providing for the sanitary requirements of such of these tracts as directly affect Simla. These are :—

(1) MASHOBRA AND MAHASU.

62. The question of the water-supply has already been dealt with elsewhere. The pipe for the water-supply has already been laid down but filter beds, storage tanks and reservoirs will be necessary at Charabra for the purification and distribution of the water-supply to Mashobra. These latter are estimated to cost Rs. 14,000. We consider it necessary that Mashobra bazaar should be supplied with a flush sewage system which is estimated to cost Rs. 10,000, but owing to its scattered nature, a flush system for the whole area is not thought feasible or at present necessary.

We suggest that for the present until a flush system can be installed for the bazaar a well controlled system of trenching should be adopted. For the private estates too far away from the proposed pail depôts, we think that some form of small septic tank for each compound offers the best solution and we suggest that experiments might be undertaken with the object of determining the form this should take. The reconstruction of the Mashobra bazaar will require careful watching. A map on a large scale has been prepared, showing existing houses and alignments. The alignments desired have been laid out in this plan, and the disposal of all future applications for building or reconstruction should be regulated by its provisions. The cost of these proposals should logically be met from Mashobra funds. We understand, however, that there may be difficulty in imposing any form of taxation on the Indian population, and the yield is likely in any case to be very small. The place is mainly frequented by residents of Simla, who would be the first to suffer from any epidemic outbreak. In the circumstances we think the expenditure necessary may be included in the general scheme, while leaving it to the local authorities to determine what portion, if any, can be subsequently recovered from the notified area.

(2) SANJAULI.

The general remarks in regard to reconstruction apply to Sanjauli. Sanjauli is already provided with a water-supply and the installation of pail depôts and a new sewage main for Sanjauli forms one of our proposals under the heading of sewage.

(3) KASUMPTI.

Kasumpti already has a water-supply and the same measures for bazaar control will be necessary here. We have included in our sewage estimates the erection of a six-seated flush latrine.

V.—GENERAL IMPROVEMENTS.

(1) PROVISION OF QUARTERS BY GOVERNMENT FOR THEIR EUROPEAN EMPLOYÉS.

63. We have already expressed our opinion that adequate provision should be made by Government for their Indian employés and we are of opinion that similar provision should be made for the European employés in Simla, although the matter is not of such urgency from the sanitary point of view as the provision of healthy quarters for the Indians, who live as a rule in the bazaars. On investigation we find that there are 429 European employés of Government in Simla with a total of 847 dependents. The number provided with Government quarters is only 65. A scheme for the provision of more quarters on the Bemloe estate which is the property of Government is, we believe, under consideration; and we suggest that it should be pressed to completion.

The slopes below Summer Hill, beneath the railway could provide ample room for accommodating all the European employés but there are we understand objections to a large colony being established here, owing to its vicinity to Viceregal Lodge. The other estates purchased by Government should in the first instance be utilised to their full extent.

(2) MEANS OF COMMUNICATION.

64. In appendix 1 will be found a list of the 1907 Committee's recommendations for the improvement of existing roads and their proposals for new roads. A summary is also given of the new roads which have been constructed and a short account given of the work which has been done on the remaining proposals.

All the proposals of the 1907 Committee aimed at increased facility of communication between different parts of Simla. We think that the remainder of the programme might be undertaken as Municipal funds permit. Having regard to our instructions we have limited our recommendations to the following four roads, which we think should be constructed in connection with the present programme. They either assist in opening out congested areas, or effect a definite sanitary improvement:—

- (1) A new road from Dhar village *via* Phagli and Sarhan villages to the neighbourhood of the Government High School. This proposal is fully discussed elsewhere in paragraph 58 and is part of the scheme for relieving congestion in the Main Bazaar.
- (2) The improvement and regrading in places of the road from the Cart Road to Sarhan village.
- (3) The completion of the Church-Convent-Jakko road. This road was suggested both by the 1898 and 1907 Improvement Committees, and has been partly constructed. A driving road has been constructed from the Convent to Barnes Court, and in continuation of this a rickshaw road has been made from Forest Hill as far as Hainault. The completion of the portion from the Church to Hainault has been under consideration at various times. After inspection of the route, especially the portion between the Church and the United Service Club, we are strongly of opinion that the construction of this road would not only improve immensely the means of communication in Simla, but also effect a great sanitary improvement, particularly in the area between the Church and the United Service Club, which is very congested with ill built bungalows and many servants' quarters. It is now difficult of access, and in a very bad condition from a sanitary point of view. Our proposals contemplate the demolition of one of the worst bugalows in this quarter.

The uncompleted portion between the Church and Hainault falls naturally into three portions:—

- (1) From Hainault to the boundary of the United Service Club.
- (2) From this point through the United Service Club grounds to the Combermere Nullah.
- (3) From the Combermere Nullah to the Church.

The alignment of the first and third portions naturally depends on that chosen for the middle portion. Two routes have been considered at various times since 1905, which may be called the upper and lower alignments. The latter is naturally the more easy grade but passes through many of the Club buildings and the acquisition of these would be expensive and would interfere unduly with the privacy of the Club quarters. The stables of the Club would also be in the immediate vicinity of the road above and below. The upper alignment while still passing through the United Service Club grounds would do so at a higher level and would necessitate the demolition of one small workshop only. We are of opinion that this route should be chosen.

No reasonable objection to the scheme can, in these circumstances, be taken on the part of the Club, and we consider that if the Committee refuse to part with this portion of their property on reasonable terms and continue, as in the past, to attach impossible conditions, it should be acquired by the ordinary process of law.

The section from the Church to the Combermere Nullah will proceed at an even level past Rivett's premises, the dip here being filled up. It will then be regraded evenly towards Ingledene, which bungalow will be acquired and removed. Its course will then be between Carlingford and Franklin House and across the Combermere Nullah to the United Service Club boundary.

The section between Hainault and the United Service Club will present little difficulty. The road already exists but will require regrading at various parts and some compensation will be necessary to the owners of some of the neighbouring estates, for small portions of land taken for the regrading and widening. We propose that a 12 foot road be constructed similar to the portion already made from Forest Hill to Hainault.

The cost of the road is estimated at Rs. 75,000, made up as follows :—

	Rs.
Cost of construction	43,000
Cost of compensation	32,000
	<hr/>

The latter figure is arrived at as follows :—

	Rs.
1. Compensation on section between Hainault and United Service Club	2,300
2. Compensation for the portion within the United Service Club property	10,000
3. Compensation on section between United Service Club and Church	17,505
4. Compensation for temporary inconvenience to householders ...	2,000
	<hr/>
	31,805
	<hr/>
	say 32,000
	<hr/>

(4) The improvement to the road leading from the Mall to Elysium through the Lakkar Bazaar is described in the section dealing with that bazaar.

65. We have also considered what improvements in the communications of Simla could be effected by means of electric lifts, electric tramways, and small electric motors.

(3) ELECTRIC LIFTS.

66. We have elsewhere considered the proposition of a lift from the proposed Dhar Phagli road to the vicinity of Gorton Castle which we recommend as a feasible and useful proposal.

A lift from Annandale to the Mall we consider of such doubtful feasibility and utility that we do not recommend its further consideration.

We have received a suggestion from the Agent to the Nabha Durbar that an electric lift should be constructed from the Nabha Estate to the Mall. The proposition has been examined by Mr. Meares who considers the proposal possible. We agree that such a lift might be considered in the light of a public improvement to Simla and that facilities might be given by Government to the Nabha Durbar to acquire the necessary land on the Mall for a terminal point. Mr. Meares pointed out that a lift from the Mall to Abergeldie in the neighbourhood of the Combermere Nullah was a proposal that might be a paying one. The proposition is an attractive one, and the lift might be constructed so as to carry rickshaws. It would greatly improve communication with the upper slopes of Jakko. This, however, can be left to the future.

(4) ELECTRIC TRAMWAYS.

67. Mr. Meares has gone into the question of electric tramways on the Mall and has given his opinion that no such project could pay a dividend. We are unable therefore to make any recommendations on this head.

(5) SMALL ELECTRIC MOTORS.

68. There are in and around Simla some 20 miles of roadway which are suitable for small motor traffic, and one is justified in assuming that the introduction of small motors, electrically driven, would tend to diminish the hordes of rickshaw coolies infesting Simla. We are of opinion that there is considerable scope for the development of such traffic and that the present municipal bye-laws might be relaxed in certain directions to allow of experiments being made with small electrically driven motor vehicles. Ultimately some such self-propelled motor, suitable for Simla, might be evolved.

It is probable that, with the removal of the present restrictions, private enterprise would undertake the experiment, and that it would prove extremely remunerative. We print as appendix 29 an interesting note by Captain Battye, who describes the type of light car which may be evolved.

VI.—FOOD SUPPLIES.

69. *Milk*.—The question of the milk supply of Simla, which is one of great importance and difficulty, has received our careful attention. At present the milk supply of Simla is derived from various sources.—

(1) Cows and buffaloes are kept by private individuals for their own use.

(2) The following licensed dairies supply milk :—

(i) Messrs. Keventer's Dairy on the Mall.

(ii) Mr. Peachey's Dairy at Fay Lodge.

(iii) Mrs. DeSouza's Dairy at Hughes Dell.

(iv) The Curzon Dairy

(v) The Agra Dairy

(vi) The Dalhousie Dairy

} in the Municipal Market buildings.

The first three of these supply their own milk ; the others retail milk bought from local gwalas.

(3) Milk is purchased by private individuals from licensed and unlicensed gwalas within and without municipal limits. The number of licensed gwalas is approximately 130 and the number of unlicensed gwalas is estimated at about 200. The majority of these gwalas reside outside municipal limits and no control whatever can be exercised over their cow sheds and surroundings.

(4) In the bazaar, milk is retailed by unlicensed hulwais, about 50 in number.

The licensed dairies are under partial supervision. The premises of the gwalas, both licensed and unlicensed, are largely outside municipal limits and therefore cannot be inspected or controlled in any way. Most of them are in Native States. The only condition attached to the grant of licenses to these gwalas is that they must purchase a milk receptacle from the municipality. The possession of a license is therefore no guarantee whatever of the purity of the milk, although it lessens the dangers of pollution during transit.

70. In England the question is simplified by the fact that only cow's milk is sold. The standard fixed for this is that it should contain 3 per cent of fat and 8·5 of total solids not fat as a minimum. In India the question is complicated by the fact that both cow's milk and buffalo's milk is consumed. The percentage of fat in Indian cow's milk is higher than in English milk being roughly about 4·5 while the percentage of fat in buffalo's milk is still greater being on an average over 6 per cent. It will thus be seen that the application of English standards would be quite unsuitable to India. The standard for cow's milk would be too low and still more so for buffalo's milk.

Moreover buffalo's milk diluted with water will as far as fat content is concerned resemble pure cow's milk so that any attempt to detect adulteration by examination of fat contents proves futile, if the exact source of the milk is not known. The question arises whether any other standard can be adopted for Indian milk which will be common to both cow's and buffalo's milk. It has been found that the amount of lactose in Indian cow's and buffalo's milk is roughly 4 per cent and it is thought that the amount of lactose may be adopted as an Indian standard for milk.

71. All over India, unless special precautions are taken, the milk supplied to the public is largely adulterated with water. In Simla the amount of water added by the gwala is roughly 10 to 65 per cent. As the water added is usually from some wayside stream, such diluted milk is frequently the cause of sporadic cases of enteric fever in Simla.

It is apparent that at the outset very great difficulties will be encountered in any attempt to control milk supplies in India. Any attempt to enforce strict sanitary control is likely to lead to an immediate rise in price. Measures to be successful must be introduced gradually and gwalas and milk sellers and, what is more important, the public generally must be made to realise that it is to their own benefit to see that as pure milk as possible is supplied and bought. We think that it would be useless at this stage to recommend ideal measures which although easy enough in themselves to formulate cannot be enforced. We submit the following ideas as a basis for a tentative scheme. At a later period when milk suppliers and the public are familiar with these measures and are convinced that they are all for their own advantage more drastic control may be possible.

72. We suggest that every gwala bringing milk to Simla should be licensed, and that a condition of the licence should be that milk is brought only in sanitary receptacles of an approved pattern. We propose that a dépôt should be established in the Market under the control of the Health Department. This dépôt will test, sterilise and bottle any milk brought to it. There will be no compulsion on the gwalas to bring their milk to the dépôt, but efforts should be made to render it to their advantage to do so. It would be of great assistance if public institutions such as the Walker and Ripon Hospitals, schools, etc., would refuse to take milk unless in sealed dépôt cans. Notices might also be sent to householders and the fact that clean sterilized milk can be procured should be widely published. The milk would be tested and prices fixed on its butter fat contents. Should the gwala wish to water his milk he might do so but the watered milk would be penalised to a slight extent. The colour of the seal or the number on it would indicate to the consumer the value of the milk he was buying. The success of a voluntary scheme of this nature would of course largely depend on tactful management, and the measure of public support which it secured.

In regard to the question of sterilization, we have examined the pamphlet on the electrical sterilization of milk issued by the Bacteriological Department of the City of Liverpool—which has lately introduced this method, apparently with success. While the milk is not rendered completely sterile, all pathogenic germs are entirely destroyed. The milk keeps sweet for a very long time and its nutritive qualities remain unchanged. As a method of sterilization it seems to offer many advantages and with the electrical power available in Simla the installation of the necessary plant should present no difficulties.

73. *Butter*.—The greater portion of the butter sold to the European population of Simla arrives from outside sources; from Aligarh, Agra, Ahmedabad and Dalhousie. It is obvious that the local sanitary authorities cannot control its manufacture. We have ascertained however that the dairies furnishing this butter are in most cases open to inspection by the authorities and it is thought that no action is necessary on this point. A certain amount of butter is manufactured locally, by the licensed dairies, from milk obtained from the local gwalas. Previous to the cream being separated the milk is sterilized by boiling. These dairies are under the control and inspection of the Health Officer. No butter is sold, or made for sale, except in licensed premises.

74. *Aerated waters*.—Licenses for the manufacture of aerated waters in Simla must be obtained from the Municipality who satisfy themselves that piped water-supply is laid on to the premises. In this connection the only recommendation we would make is that the use of filters is quite unnecessary and possibly dangerous and further that the water used in the manufacture should run directly in closed pipes and vessels from the tap to the bottle. There should be no opportunity of the water being contaminated by storage in open cisterns.

75. *Fruit*.—We consider it anomalous that while vegetable sellers require a license, fruit sellers are entirely exempt from any such obligation. We consider that licenses for the sale of fruit should be granted by the Municipality so that the health authorities may have control over the sale of fruit.

76. *Sweetmeats*.—During our inspection of the bazaars we were much impressed by the fact that all sweetmeats exposed for sale are liable to contamination by road dust and by flies and wasps. We think in certain circumstances that this might constitute a grave danger to the health of the inhabitants and we recommend that all hulwais and sweetmeat makers and sellers should be licensed and that among the conditions of the license should be the keeping of a clean shop, not used as a place of residence and the provision of glass almirahs, for the storage of sweets, etc.

77. *Meat Markets and Slaughter Houses*.—We do not share the opinion of the 1907 Committee that it is necessary to provide slaughter houses at Kaithu and Chota Simla. We are of the opinion that it is much better to have a slaughter house in a central position, as it is at present, with facilities for central control and inspection. We consider that the present slaughter house is sufficient to meet all the needs of Simla in this respect. Further, we are of opinion that it is unnecessary to acquire any part of the Kaithu Jail as a meat market and bazaar. We see no objection, however, to establishing meat markets in Kaithu, Chota Simla and Boileauganj, should there be a desire for them on the part of the inhabitants of these areas.

78. *Vegetable Markets*.—The present vegetable shops are situated at the east entrance of the public market. The street is narrow and the shops dark, dirty and difficult to keep clean. The site, however is very suitable for a vegetable market; were the present shops dismantled, the street widened and the shops rebuilt on a better design, after the manner of the three vegetable shops at present in the Municipal Market. An alternative would be to build a new vegetable market on the vacant municipal land above the meat market. As these, however, would be paying propositions they may well be left to municipal enterprise.

VII.—SUGGESTED LEGISLATION.

79. The question of dealing with congested and insanitary areas in towns is one that has been much discussed in India of late, and in their circular letter of 9th August 1912, the Government of India addressed all Local Governments on the subject. In the Punjab the matter was fully discussed at the recent Sanitary Conference, and has been dealt with by the Punjab Government in a Resolution, dated 11th August 1914.

We desire to make the following specific suggestions for the amendment of the law. The powers we suggest might be conferred on selected Municipalities, which should certainly include Simla where full use is made of the existing provisions of the law—*e.g.*, those empowering Municipalities to close houses unfit for human habitation [*vide* paragraph 6 of the Punjab Resolution]. Our suggestions follow in the main the existing English law and have been in part incorporated in the Bombay and Calcutta Improvement Acts.

80. We suggest—

1. That when buildings have been declared unfit for human habitation, power should be given to compel the owner to demolish at his own expense, when the closing order, *i.e.*, order to render fit for human occupation, has remained inoperative for 3 months.

2. That when surrounding properties are improved by the demolition of an obstructive building, or block of buildings, power should be given to apportion the compensation among the surrounding buildings or properties to the extent to which they are increased in value by the demolition of the obstructive building ; and to recover this by the levy of a private improvement rate. Obstructive buildings may be defined as buildings which stop or impede ventilation, or make other buildings unfit for human habitation or prevent any measure being carried out for remedying any nuisance injurious to health. The owner should be empowered to claim to retain the site. In such case compensation would be payable for the building only ; but no building which might be obstructive could be erected on the site. Power should also be given to acquire a portion only of the building or holding, if in the opinion of the Court a part can be severed without material detriment to the remainder.

3. That when buildings which are insanitary are acquired, the owner should not be entitled to anything in excess of the market value on account of the compulsory nature of the acquisition.

4. That in assessing compensation the fact that a house is rack rented or in an insanitary condition or unfit for human habitation should be taken into account by the assessing officer—and the compensation reduced accordingly.

81. We suggest also the following minor amendments in the Punjab Municipal Act designed to strengthen the powers of Municipal bodies to control the construction of buildings and to deal with dangerous buildings ; and to elucidate certain provisions which appear obscure.

(a) *Section 113 of the Municipal Act (Punjab Act III of 1911).*—This section does not authorise a Committee to order the demolition or dismantling of a dangerous building. Cases may be found where immediate demolition of the building will be the only safeguard against imminent danger. It is, therefore, proposed that after the words “ by notice ” the following be substituted—

“ require the owner or occupier thereof to *demolish, dismantle, repair, protect or enclose the same.*”

(b) *Section 114.*—It has been decided by the Chief Court of the Punjab that a notice under this section is invalid if it requires an owner to remove a building without giving him the option of repairing the same. It has further been held that the repairs to be made must be specified by the Committee in the notice. It has been felt that the section does not meet the requirements of many cases. It does not cover the case of a building which is so dangerous or ruinous that nothing short of its total demolition and rebuilding will make it safe. Unless the repairs required are simple the duty of advising and the responsibility of specifying the detailed repairs should not be thrown on the Committee. It is, therefore, proposed that the following words should be substituted after the word “ dangerous ” “ it may by notice require the owner thereof forthwith to do one or more of the following as the Committee may direct :—

(a) to remove, demolish or dismantle the building, etc., or part thereof, or

(b) to cause such repairs to the building, etc., or part thereof as the Committee may consider necessary for public safety,”

and add a proviso

“ provided that if the Committee order the removal, demolition or dismantling of the building, etc., or part thereof under clause (a) so as to prohibit the re-erection thereof, then in that case the Committee shall make full compensation to the owner for any damage which he may sustain in consequence of the prohibition. Provided also that the Committee shall not be liable to make any compensation in respect of the prohibition of the re-erection of any building, etc., or a part thereof which for a period of three years or more immediately preceding such prohibition has ceased to be fit for occupation.”

(c) *Section 125.*—This section as it now stands might be read as not authorising the Committee to *convert* a latrine of one pattern into that of another. Its scope appears to be limited to requiring the provision of new or additional latrines, etc., and the moving or removal of existing latrines, etc. To make it

more explicit, it is proposed that the following changes should be made in the section after the word "refuse"—

"or provide any drain, privies, latrines, urinals, cesspools or other receptacles as aforesaid whether in addition to or in place of the existing ones".....

It must be noted that this section deals with latrines, etc., in existing buildings. The case of new buildings will be governed by section 190 and bye-laws under that section.

(d) *Section 190, Clause (b).*—This clause deals with the material and method of construction of latrines, etc. It does not authorise the Committee to require that a building when being constructed "*should be provided*" with latrines, etc., and the word "pattern" of latrines, etc., which occurs in section 125 does not occur in this clause, so that it would be possible to argue that this clause does not authorise the Committee to insist on a particular pattern of latrines, *e.g.*, flush latrines. It is, therefore, proposed that between the word "the" in the beginning of the clause and the word "material" the words "*provision, pattern*" should be inserted.

(e) An additional clause will be useful to this section as follows :—

(b) generally provisions for securing the stability of buildings and for purposes of health.

(f) Section 190 does not empower the Committee to make bye-laws regulating the construction of houses according to approved designs, nor does it require a notice of completion of buildings by owners. A new section giving these powers to selected Municipal Committees will be a very useful measure. Such powers exist in England.

(g) *Section 190-A.*—To this end, it is suggested that a new section should be enacted as follows :—

"190-A.—The Committee may in addition to matters mentioned in section 190 by bye-law provide in respect of erection or re-erection of any building within the municipality or part thereof—

- (a) that such buildings shall be constructed according to type or design approved by the Committee,
- (b) require that notice of completion of buildings shall be given to the Committee,
- (c) regulate the inspection of buildings during and after construction,
- (d) provide that buildings shall not be occupied till certified to be fit for occupation and to have been built in conformity with the sanction granted.

Provided that this section shall not apply to any Municipal Committee till it has specially been extended thereto by the Local Government by notification in the local official gazette." The proposed section is self-explanatory.

If the new section 190-A. is approved then as a necessary consequence of clauses (a), (d) and (e) the following amendment to section 195 follows :—

"(h) 195.—Should any building be begun, erected, or *occupied*

(f) in contravention of any bye-law made under section 190 or 190-A.

the Committee may.....require the building to be altered, demolished or *closed*....."

In the second proviso the word "*closing*" should be added after the word "demolition."

Section 225 should be amended so as to give a right of appeal from orders refusing a certificate under section 190-A, clause (e).

Restriction of buildings in certain areas.

82. We think that the whole of the Mall from Chota Simla to Viceregal Lodge should be declared a restricted area under the provisions of section 193 of

the Punjab Municipalities Act. This section restricts the erection or re-erection of buildings or any class of buildings within specified limits, in pursuance of a general scheme, for the prevention of overcrowding, or in the interests of the residents, or for any public purpose. These powers, with the new section 190-A, which we propose, may enable the Committee in future to prevent architectural monstrosities such as now disfigure the Chaura Maidan and other localities.

Similar measures should be taken with regard to Summer Hill; and we think it is desirable, if jurisdiction is acquired over Tal Hill, to take similar powers.

Minor recommendations.

83. We have received various suggestions for general improvements from residents of Simla, and from the Simla House Proprietors Association. Many of these are embodied in our general proposals. The remainder are comparatively minor matters, not affecting large sanitary principles, and we have referred them to the favourable consideration of the Municipal Committee.

VIII.—QUESTIONS OF TAXATION AND FINANCE.

(a) Existing taxation.

84. We have considered the possibility of increasing taxation in Simla in order to provide a portion of the large sums necessary to carry out the programme which we propose. Simla is, however, very highly taxed in comparison with other Municipalities. The table which is printed as Appendix 28 shows that the rate of taxation is Rs 15-2-0 per head. It is difficult to estimate the exact population yearly, but the rate has risen so far as we can judge from Rs. 13-3-0 per head in 1909. The only other Municipalities which approach these figures are Mussoorie, where the rate is Rs. 10-1-3 per head, Darjeeling where it is Rs. 8-6-9, and Naini Tal, where it is Rs. 8-2-3. In Ootacamund the rate is Rs. 6-12-10 per head. Taxation in other Municipalities in the Punjab, with the exception of Murree and Rawalpindi varies from annas 12-2 to Rs. 3-6-6 per head.

85. We deal with the taxes in force *serialim*.

(a) *Octroi* is imposed on a very large range of articles, and it is proposed further to revise the schedule and raise the rates, thereby increasing the annual income by Rs. 31,000, in order to make up for the abolition of the conservancy tax. It is not in our opinion possible further to increase the octroi rates.

(b) *Taxes on buildings and lands.*—The ground tax in the station ward in its present form presents anomalies in that it is levied at a rate of Rs. 10 for every 2,500 square yards or about 1 pie per square yard or less, irrespective of the number of bungalows in the same ownership on the estate. The unit of area should be smaller, and the tax so graded that properties in densely populated areas may pay their fair share. We do not, however, consider that any considerable enhancement of the tax is desirable. Such an enhancement would involve an immediate increase in house rents. The inadequacy of the receipts from ground tax (including tehzamini) in the Bazaar was alluded to in paragraphs 49 and 50 of the Report of the Improvement Committee of 1907. The law has since been amended as there suggested and steps are now being taken by the Municipal Committee to revise and increase the tax with effect from next year. We have allowed for an increase of Rs. 7,000 under this head in our financial forecast. No further substantial enhancement appears to be possible.

(c) *House tax.*—The house tax is at present at the rate of 10 per cent. 12½ per cent is legally admissible. An increase of 1 per cent, is estimated to produce Rs. 18,000 per annum. Here again, however, the increase would fall on the overtaxed occupier and a rise of house rents would inevitably follow, equalling or more probably exceeding the increase in tax. This we think it is most desirable to avoid.

(d) *The Conservancy tax.*—This tax was recently abolished for most excellent reasons. Any form of poll tax is necessarily unfair in its incidence ; and personal taxation of this nature is peculiarly unsuited to a place in which the population is largely migratory and subject to seasonal variations. The tax was largely evaded, and the cost of collection was nearly 20 per cent. of the proceeds. Its burden largely fell on residents and employers, and led to a general increase in the wages of menial servants.

(e) *Taxes on vehicles and animals, and servants' and dog taxes.*—No appreciable increase can be expected from these minor sources of revenue.

(f) *Water rate and sale of excess water.*—No increase is possible here. We deal with the question and that of electric rates in the succeeding paragraphs.

We do not, therefore, consider that any further substantial increase in taxation is possible.

(b) *Water taxation and free allowance.*

86. In Simla at present, water tax is levied under section 61 of the Municipal Act on all premises whether or no they be connected with the water mains. The present rate is 2 per cent on the annual value. Free allowances of water are given under section 97, the amount varying according to the annual rental, but certain special allowances are granted, *e.g.*, for latrines at Bishop Cotton School. All connections are metered and meter rents, varying from Rs. 6 to Rs. 12 per annum, are charged. Water taken in excess of the free allowance is charged for under section 97 of the Act, the rates being Rs. 3 per thousand gallons during April, May and June, Re. 1 per thousand gallons for the rest of the year. We have considered the question whether it is possible to increase the free allowances of water and have also consulted the Municipal Committee on the matter. They have deprecated any such increase in the free allowance of water as would involve diminution in the present revenue. We agree that in view of the financial position no such diminution is possible. We are of opinion, however, that the water used for all private latrines in houses and in compounds should not be charged for and that such connections should either not be metered or that a definite allowance for such latrines should be added to the free allowance already allotted to the premises. By this no reduction in the present income from excess water will result to the Municipality. In a note printed as Appendix 9 the Engineer allows 50,000 gallons for a 25 per cent increase of free allowance. When this note was written, however, it was probably not contemplated that a universal extension throughout Simla of a water-carriage sewage system such as we now recommend would be adopted in the near future. We are of opinion that this amount should be added to items 2, 3, 6, and 9, in estimating the future amount of water required for the extension throughout Simla of the flushing system.

(c) *Electric rates.*

87. We were directed to consider the question of the rates to be charged for electric power in connection with the general financial position of the Municipality, and its ability to bear any further charges on account of the schemes for sanitary improvements. The rates fixed by the Municipality on the completion of the first part of the hydro-electric scheme were 4 annas for lighting and 2 annas for power, for heating and cooking, $\frac{3}{4}$ of an anna in the four winter months, and one anna for the rest of the year. Special contracts for large consumers are also allowed. The Punjab Government are of opinion that at these tariffs the scheme does not pay at present and, assuming that it is necessary for the Municipality to raise additional loans which they cannot finance on their existing income, they consider that the rates ought to be raised 50 per cent. at an early date. The Municipal Committee, however, object to raising the rates on the grounds that pledges have been given to the public and considerable expense incurred on the strength of those pledges. They consider further, that when the proposed extensions are completed, the scheme will

yield a substantial profit; and they fear that an increase in rates may check further extensions and cause a loss of income.

In support of their argument the Municipal Committee have furnished figures to show that the total capital cost of the installation, including the first extension shortly to be completed, amounts to Rs. 18,95,000. The maintenance charges are estimated at Rs. 77,000 and depreciation charges, calculated on a scale to replace all works and machinery where necessary, at Rs. 50,000. The income, when the first extension is completed, is estimated at Rs. 2,05,000. The surplus is, therefore, Rs. 78,000 which works out to slightly over 4 per cent on capital cost.

There is considerable force in the arguments adduced by the Municipal Committee, which are supported by Mr. Meares. We consider, however, that, if it is found necessary to strengthen the financial position of the Municipality, recourse must be had to this source rather than to the enhancement of taxation, which, as we have shown above, is in Simla largely in excess of that in other municipalities. We would propose, therefore, in view of the arguments put forward, that no increase should be made to the electric rates for 6 or 7 years. But we consider that by that period an additional income of Rs. 31,000 may reasonably be expected from this source. If this income is produced at present rates and experience shows that the retention of the present rates is on the whole the more remunerative, no change will be necessary. If, on the other hand, the necessary income is not produced, there will be no alternative but to raise the rates by at least one anna, which will, it is estimated, produce the necessary Rs. 31,000.

(d) *General Financial Survey.*

88. As will be seen from the details given below, the total cost of all the works which the Committee has recommended amounts to Rs. 38,50,818 :—

					Rs.
1. Water	...	...	...	...	6,59,000
2. Sewage	...	...	...	...	6,80,000
3. Drainage, ravines and nullahs	...	...	...	...	1,60,075
4. Destructor and covering chute	...	...	...	...	35,000
5. New incinerators	...	...	...	...	17,500
6. Dhobi Ghats	...	...	...	...	40,000
7. Disinfectors	...	...	...	...	10,000
8. Church Road	...	...	...	...	75,000
9. Improving cart road to Sarhan road	...	...	...	...	3,000
10. Acquisition of land at Dhar	...	...	...	...	1,61,000
11. Dhar-Phagli Road	...	...	...	...	20,000
12. Lift	...	...	...	...	1,00,000
13. Acquisition of bazaars	...	...	...	10,18,001	
<i>plus 10 per cent.</i>	...	...	...	1,01,800	
					<hr/>
					11,19,801
14. Reconstructions	...	...	...	...	7,70,442
					<hr/>
				Total Rs.	38,50,818

Of this a sum of Rs. 1,61,000 is for the acquisition of land at Dhar with a view to building thereon houses for the clerks in the employ of the Government of India. This Dhar housing scheme is essentially one for the consideration of the Government of India in the Public Works Department. It will be not only useful but profitable, and should, we think, be taken up by the Government of India, and dealt with independently of the Municipality. It may, therefore, be properly excluded from the expenditure to be considered in this

section of the Report. A further sum of Rs. 1,20,000 has been estimated for the lift to the main road and the new road to be constructed between Dhar and Phagli. The carrying out of these works would of course be contingent on the acceptance and adoption by the Government of India of the Dhar house building scheme, and they would not be undertaken until the property at Dhar has been acquired and the Public Works Department has commenced operations. In view of the fact that the road and the lift are really ancillary to the Dhar house building scheme and that their construction will substantially appreciate the value of the property at Dhar, we think that the initial cost of the lift and of the road might be considered a portion of the Dhar scheme, and that a grant of Rs. 1,20,000 equivalent to the initial cost of these two works might reasonably be given by the Government of India. It would, however, be probably more convenient that the work of construction should be carried out by the Municipality, and it seems fair that the subsequent maintenance charges should be met by that body.

89. Excluding the three items dealt with above, the total cost of the projects recommended amounts to Rs. 35,69,818. It is, however, necessary to consider in this connection the provision of a new Municipal Town Hall. The estimate for this work including departmental charges, is Rs. 9,25,025. The total amount, therefore, for which it is necessary to provide funds is Rs. 44,94,843. This amount can again be divided into two clearly separate portions:—

(i) Extension of water and sewage works and other works which fall within the scope of the normal duties of the Municipality. With the addition of the Town Hall, the total of the first 9 items detailed at the beginning of paragraph 88 above amounts to Rs. 26,04,600.

(ii) The acquisition and re-construction of insanitary areas in the bazaar the cost of which is estimated at Rs. 18,90,243.

90. As regards the financing of the works dealt with in class (i) above.

The table printed as Appendix 27 shows the present financial position of the Municipality and the income and expenditure which may be expected in future years, if the proposals as to conservation and water and sewage improvements are carried into effect.

It will be seen that the major portion of the debt which the Municipality has at present to discharge will be paid off in 1920-21 and that in 1921-22 there may reasonably be expected a surplus income of Rs. 82,000. The question of raising the price of electric supply has been discussed in paragraph 87 above, and we have recommended that, if it cannot be obtained at the present rates, an increase should be made in the rates for electrical supply so as to ensure an additional income of Rs. 31,000. There will thus be in the year 1921-22 an annual surplus of Rs. 1,13,000 against which the Municipality can legitimately borrow. The amount which can be borrowed on the usual terms of a thirty years loan with annual repayments of Rs. 1,10,200 is Rs. 19,00,000, and we would propose that this sum should be lent by Government with the additional concession that the capital sum should be made available as required between now and 1921-22 and that repayment of the 30 instalments should begin in the latter year and that in the interval no interest should be charged. If such a loan be agreed to, and if the entire amount of this loan be devoted to financing work of this class, it will be necessary to provide an additional sum of Rs. 7,04,600 and this amount, we propose, should be given by Government. To secure the necessary control over this expenditure, we would make it a condition that the total sum of Rs. 26,04,000 should be applied only to those definite objects mentioned above, that quarterly progress statements should be furnished to the Government of the Punjab and the Government of India in the Education Department, and that the Municipality should be responsible for meeting any excess over the estimates. This arrangement should secure the financial control, the importance of which has been insisted upon.

91. The work of acquisition and reconstruction of certain insanitary areas, for which the estimate of Rs. 18,90,243 has been prepared, we regard as only a portion of a scheme which will have the most far reaching results in improving the sanitary conditions and health of Simla. It will be seen that this

Committee have in their present proposals dealt with only certain of the most insanitary portions of the Simla Bazaars. These they propose to acquire and demolish and to rebuild on the sites available, having due regard to open spaces and sanitary conditions, houses of an improved pattern which they propose at present to let. The estimates framed for such an undertaking must be necessarily tentative, although we have allowed a liberal margin for error. The estimates as framed amount roughly to an expenditure of Rs. 18,90,000 from which an annual income of Rs. 50,000 will, it is hoped, be derived in rents. Taking this sum at its capitalised value at 4 per cent it will be seen that the real cost of the transaction is Rs. 6,40,000. It is for consideration, however, whether better financial results could not be obtained in some localities by a re-sale of the sites selected as suitable for building subject to stringent conditions as to the type, etc., of house to be erected thereon. The matter is, however, one on which an accurate estimate can only be obtained by actual experience but even if the cost should come to Rs. 6,40,000 this sum would be well spent in the improvement of the areas selected which are a standing menace to the health of Simla. On the other hand if the working out of the scheme should show that it were possible to carry it out at a reasonable cost, we consider that it would be well worth the while of Government to devote a further sum of money to deal similarly with other portions of the bazaar, many of which are little less insanitary. We would propose, therefore, that in view of the importance of the subject and the necessity of securing continuity of endeavour and of financial control, the acquisition and improvement of the bazaars should be dealt with by a body entirely independent of the Municipality. We would in fact propose the constitution of a Simla Bazaar Improvement Trust on lines analogous to those of the Calcutta Improvement Trust, though it might well be constituted in the shape of one officer of suitable standing provided with the necessary technical assistance. At the disposal of the Trust Government might place the sum of 20 lakhs to carry out the reform of the portions of the bazaars proposed, the salaries of the establishment and such small additional work as the surplus might permit. In the course of this work the officer would then be able to arrive at a fair estimate of the amount of further work which should be taken up on similar lines and of its cost and from this and the result of the work on the portion actually dealt with, Government would be in a position to decide whether justification existed for (1) continuing the scheme in a comprehensive manner, (2) dealing with it partially as regards other areas of an especially insanitary nature, or (3) closing the scheme altogether and leaving further work on it to Municipal enterprise.

92. It is somewhat difficult in view of the contingencies contemplated in the foregoing paragraph to state definitely what the financial result of this proposal will be. As the work on the areas actually selected would probably extend for a period of about 3 years, and as it is unlikely that there would be any considerable return by way of rents for that period, it would be necessary to add to the *pro forma* statement of cost the sum of Rs. 2,40,000, representing 3 years' interest on the 20 lakhs placed at the disposal of the Trust, and there are further the salaries of the officers employed on the Trust. Assuming, therefore, that the scope of the Trust is confined to the acquisition, demolition and reconstruction, at a cost of 20 lakhs, of certain specially insanitary areas and that the newly constructed houses will be let at a rental, and the value of the rental capitalised and repaid to the lender of the 20 lakhs after 3 years, the total loss involved might probably be reasonably taken at about 10 lakhs. In view, however, of the wider scope which we hope the success of the Trust will justify Government in giving to its operations, the financial effect may be considerably different.

93. There is further to be taken into the *pro forma* account the interest on the loan of 19 lakhs for the period for which portions of it are taken before 1920-21. This cannot of course be actually estimated, but may be taken at $2\frac{1}{2}$ lakhs. There is the further direct grant of Rs. 7,04,600, say, Rs. 7.05 lakhs. The total, therefore, is 19.55 lakhs, should the scope of the Trust be limited in the manner described in the paragraph above. We would suggest that assistance to this extent be given by Government. It is also for the consideration of Government whether the sum of 20 lakhs should not be made over to the Trust as an unconditional grant,

leaving the assets of the fund at the end of three years to be utilised for further improvements. In that case the total assistance required from Government would be 29·55 lakhs. We understand that it is not within the scope of the Committee to suggest the division between Imperial and Provincial revenues.

94. Such are our recommendations, and we are confident that if carried out they will go far towards placing Simla in a satisfactory sanitary condition and meeting future requirements so far as it is necessary to look ahead. We have heard the argument that Simla is very well as it is; but we do not admit that this position can reasonably be sustained. Mortality doubtless is low, but morbidity is very high; and preventible disease should not be allowed to exist in a hill station which is the headquarters of two Governments for several months in the year. Nor are we justified in anticipating that, in the absence of measures designed to eradicate the insanitary areas in the bazaars and to relieve their grossly overcrowded conditions, the present relative immunity from serious epidemics will continue. We desire to recognise the great improvement brought about in the past few years by the zealous efforts of Major Needham and others; but no radical cure can be effected without large capital expenditure which it is not possible for the Municipal Committee to meet without further assistance.

95. When first constituted the Committee were fortunate in securing the services of Major Needham as Secretary. We desire warmly to acknowledge the services he has rendered us. His intimate knowledge of local conditions enabled him to put forward the various proposals in a well digested and considered form; and we were thus enabled to arrive at a unanimous conclusion on every alternative presented to us.

When Major Needham proceeded on service, Captain Stewart kindly volunteered to take on his work; and we cannot sufficiently thank him for the zeal and assiduity he has shown in bringing matters to a conclusion. Many of his suggestions are embodied in our recommendations.

Major Perry too was recalled to military duty; but he saw and approved of the report so far as it deals with the water-supply; and he also indicated his approval of the other general conclusions at which we have arrived.

We desire also particularly to acknowledge the assistance given us by Mr. Astbury, Executive Engineer, at present discharging the duties of Water Works and Drainage Engineer to the Municipality, who has prepared for us at the cost of heavy labour the various estimates connected with the water and sewage schemes and the construction of roads; Mr. A. H. Johnston, Resident Engineer, who has prepared the bulk of the estimates and drawings for our Bazaar schemes, Mr. Donald Johnstone, I.C.S., Secretary, and Mr. O'Brien, Joint Secretary to the Municipality; Lala Ramji Das, Naib Tahsildar of Simla; and Mr. Jai Lal, Member of the Municipal Committee, who has given us useful general suggestions and in particular the benefit of his legal advice and assistance. We are also much indebted to Mr. Meares for the assistance and advice he has given us in connection with the electric schemes.

L. C. PORTER.

C. P. LUKIS.

M. NETHERSOLE.

R. A. MANT.

F. W. JOHNSTON.

J. F. CONNOLLY.

E. CLARKE.

SIMLA IMPROVEMENT COMMITTEE, 1914.

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APPENDIX 1.

Statement of the 1907 Committee's proposals with a summary of works completed up to the present, works in progress and works still untouched.

The following projects were recommended by the 1907 Committee :

1. Hydro Electric and Water extension Scheme.
2. Water Supply.
 - (a) Additional Filter Beds in upper gravitation main.
 - (b) Extension of water mains within Simla.
3. *Sanitary Measures*—
 - (a) Conversion of public latrines into Flush closets.
 - (b) Provision of a separate pail depôt and sewer for Sanjauli and Chota Chelsea.
 - (c) Provision of Filters for effluent of the Septic Tanks.
 - (d) Provision of 1 large and 4 small incinerators for rubbish.
 - (e) New Small Pox Hospital.
 - (f) Extension of Sewage mains within Simla.
 - (g) Construction of Dhobi Ghats.
 - (h) Extending iron drains and paving Ravines below the lower Bazaar.
6. *Demolition of Buildings*—
 - (a) Demolition of houses in the Bara Bazaar.
 - (b) Removing Kaithu Bazaar.
 - (c) Removal of portion of Lakkar Bazaar.
 - (d) Removal of 4 shops in Chota Simla Bazaar.
6. *Markets and Slaughter houses*—
 - (a) Conversion of a portion of the Jail into a grain market and construction of a meat market in Kaithu.
 - (b) Construction of a Slaughter House in Kaithu.
 - (c) Construction of a meat market in Chota Simla.
 - (d) Construction of a Slaughter House in Chota Simla.
7. *Miscellaneous*—
 - (a) Construction of a wire ropeway for the Bazaar to the Railway Station.
 - (b) Grant for a new Dufferin Hospital.
 - (c) Porch at the Town Hall.

7. *Communications*—

I.—IMPROVEMENT OF EXISTING ROADS.—MAJOR WORKS.

1. Improving the grades and widening the road round Elysium Hill beyond the Elysium Hotel.
2. Improving the road from Petersfield gate round Kelston Hill on the east side.
3. Improving the road from Lover's walk through Kaithu to Annandale.

4. Widening and regrading the Chaura Maidan Summer Hill Temple road on the northern face of the Inverarm and Observatory Hill so as to convert it into a driving road.

5. Widening and regrading parts of the Observatory Hill-Boileauganj road to the North Guard House of Viceregal Lodge.

6. Road to Jutogh.

7. Improving the road from Long View up Jakko and down to Cordell Cot.

8. Road from Hotz's shop to the Mythe.

9. Winscottie to Belvedere.

II.—IMPROVEMENTS OF EXISTING ROADS—MINOR WORKS.

1. Improving grades of the road from Bank of Upper India *viâ* Blessington to Lovers' Walk.

2. Improving the road from the Municipal High School to Sarhan.

3. Improving the road from Ridgewood Place (Balmoral) to Forest Hill.

4. Improving road below Mr. Rivett's House to Lowrie's Hotel.

5. Improving the Belvedere-Wheatfield road.

6. Widening the Inverarm-Windcliff road.

III—PROPOSED NEW ROADS.

1. Church to Convent—Jakko

2. Belvedere to Barari—Elysium

} recommended by 1898 Committee.

3. Cooly and mule road, Main Bazaar to Chota Simla.

4. Delville-Summer Hill Railway Station-Tal Hill Saddle Cart and driving road.

5. Road Bonnie Moon-Bothwell ravine to Mall.

6. Road from Guard House, Viceregal Lodge, *viâ* Glen to long road to Annandale road.

7. Blessington-Kaithu spur-Annandale road.

8. New driving road round Summer Hill.

9. New road from Dixie to Barnes Court road to Convent, with a link from the latter to the upper Jakko road.

10. Link road from Wheatfield to new road from Blessington to Annandale.

A—The following works have been completed.

1. Hydro Electric and Water Works Extension Scheme.

2. Water Supply.

(a) Additional Filter Bed on upper gravitation line.

3. *Sanitary Measures—*

(b) New Small Pox Hospital.

(d) Provision of one large incinerator and 4 small incinerators.

6. *Miscellaneous—*

- (a) Construction of a wire ropeway from the Bazaar to the Railway Station.
- (b) Grant for a new Dufferin Fund Hospital.
- (c) Porch at the Town Hall, Rickshaw Sheds, etc.

7. *Communications.*

III—NEW ROADS.

(4). Delville-Summer Hill Railway Station, Tal Hill Saddle Cart and Driving road.

(6) Road from Guard House, Viceregal Lodge, *viâ* Glen to Long road to Annandale road.

(8) New Driving road round Summer Hill.

B—*The following works have been started but have not been completed.*

2. *Water Supply.—*

(b) Extension of water mains within Simla.

3. *Sanitary Measures.—*

(a) Conversion of public latrines and urinals into Flush closets.

(f) Extension of sewage mains within Simla.

(h) Extending Iron Drains and paving Ravines below the Bara Bazaar.

4. *Demolition of Buildings.—*

(a) Demolition of buildings in Bara Bazaar.

(b) Removal of a portion of the Lakkar Bazaar.

7. *Communications.—*

I.—IMPROVEMENT OF EXISTING ROADS.

(2) Improving the road from Petersfield gate round Kelston Hill on the east side.

(4) Improvements to Chaura Maidan-Summer Hill Roads.

(8) Road from Hotz's shop to the Mythe.

II.—IMPROVEMENTS OF EXISTING ROADS.

3. Improving the road from Ridgewood Place to Forest Hill.

6. Widening the Inverarm-Windcliff road.

III.—PROPOSED NEW ROADS.

1. Church to Convent—Jakko.

2. Belvedere to Barari—Elysium. This has been very nearly completed and only a small portion remains to be done.

3. Cooly and mule road, main Bazaar to Chota Simla. A small portion of this has been made from the Cart Road below Carlton Hotel to the tunnel under Ravenswood.

5. Road Bonnie Moon-Bothwell ravine to Mall. A small [portion of this has been made from the Bonnie Moon end.

7. Blessington-Kaithu Spur-Annandale road. A small part of this has been done from Kaithu Octroi Post as far as Buchail village.

C—*This therefore leaves a list of projects as detailed below which have not been touched at all.*

Sanitary Measures.

- (b) Provision of a separate pail depôt and sewer for Sanjauli and Chota Chelsea (Convent).
- (c) Provision of filters for the effluent of the Septic Tanks.
- (g) Construction of Dhobi Ghats.

Demolition of Buildings.—

- (b) Removing Kaithu Bazaar.
- (d) Removal of 4 shops in Chota Simla Bazaar.

Markets and Slaughter Houses.—

- (a) Conversion of a portion of the Jail into a grain market and construction of a meat market in Kaithu.
- (b) Construction of a Slaughter House in Kaithu.
- (c) „ „ Meat Market in Chota Simla.
- (d) „ „ Slaughter House in „

Communications.

I.—IMPROVEMENT OF EXISTING ROADS (MAJOR WORKS.)

1. Improving the grades and widening the roads round Elysium Hill beyond the Elysium Hotel.
3. Improving the road from Lover's Walk through Kaithu to Annandale.
5. Widening and regrading parts of the Observatory Hill-Boileauganj Road to the North Guard House of Viceregal Lodge.
6. Road to Jutogh.
7. Improving the road from Longview up Jakko and down to Cordell Cot.
9. Winscottie to Belvedere.

II.—IMPROVEMENTS OF EXISTING ROADS.

1. Improving grades of the road from Bank of Upper India, *via* Blessington to Lover's Walk.
2. Improving the road from the Municipal High School to Sarhan.
4. Improving the road below Mr. Rivett's house to Lowrie's Hotel.
5. Improving the Belvedere-Wheatfield road.

III.—PROPOSED NEW ROADS.

7. Blessington-Kaithu Spur-Annandale Road.
 9. New Road from Dixie to Barnes Court Road to Convent with a link from the latter to the upper Jakko Road.
 10. Link Road from Wheatfield to new Road from Blessington to Annandale.
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APPENDIX 2.

General Description of the Catchment Area from which Chair Water Supply is derived.

The water collected at Chair is derived from the catchment area formed by the slopes on the north side of the ridge between the villages of Kufri and Phagu—above and below the new Hindustan-Tibet Road, and mainly below about the 9th milestone and Phagu village, and beyond.

Above the Hindustan-Tibet Road there is one village, Golu Village, with some 30 inhabitants. On the road itself and below Golu Village there is a collection of 3 or 4 houses and huts. These later are usually only occupied during the potato season, or on special occasions.

Below the road and dotted here and there in the catchment area are single crude houses and huts or small groups of houses and godowns.

The houses are occupied by the small farmers and families who cultivate the land in the vicinity. None of them have any conservancy arrangements whatever.

The catchment area is divided up into two main nullahs, the Bithu-ka-nullah and Pinjaul-ka-nullah, the slopes of each being scored by numerous tributary and smaller nullahs. These two nullahs converge at Chair, where the water is collected for pumping.

There is little forest land, the hill-sides are more or less uncovered by trees, often stony but with numerous patches of rough pasturage and terraced cultivation.

The whole area is traversed by numerous hill paths and tracks. Part of the old Hindustan-Tibet Road runs through the area. The new Hindustan-Tibet Road also cuts through the upper limits of the area as far as Phagu village. On this road there is constant traffic, with all the possibilities of contamination associated therewith. During a walk along the road amid clouds of dust, I counted 380 mules in half an hour from 8 A. M. to 8-30 A. M., between the 9th and 11th milestones. The mules are in strings of 3 to 6 and each has a driver in charge. This was in early October when the potato traffic was at its height.

A walk along the two nullahs at about the 7,000 feet contour (*i.e.*, about 1,000 feet below the level of new Hindustan-Tibet Road) is instructive. The land here is suitable for crops and grazing, and many areas are under cultivation. Potato crops occupy much of the land. This land is manured. Other crops are Indian Corn, Wheat and Bittu.

During the walk along this contour I talked with 15 or 20 individuals, residents of and living in the area. They told me that they estimated the number of cattle in the area at about 500 to 600, and sheep from 700 to 800, and that 200 people were permanent residents, and this latter number increased considerably during the seasons when extra help was needed on the land, or when coolies stayed for the night *en route* East or West during certain times of the year. These figures may be quite unreliable but during my inspection I counted 70 cattle and 50 odd sheep and as noted above talked to 15 or 20 people.

On one occasion (in October) I attempted to climb directly down from the 10th milestone on the Hindustan-Tibet Road to the Chair pumps, but beyond the level of 7,000 feet a bee line descent is not possible. Much climbing and many detours are necessary. The hill sides slope precipitously down to the nullahs in places and cannot be negotiated.

As one gradually drops down from 8,000 feet to about 7,000 feet one notices on the nullah sides and on the slopes good grass and shrubs—and 3 inches or so below the surface the soil is obviously damp.

Soon a trickle of water appears on the sides of the smaller nullahs, and as one descends a tiny flow at the bottom of the nullahs becomes apparent. It is in this way the water first appears. In places where the water accumulates the natives have constructed little stone dams for its handy collection, and they told me that as the sources of upper levels dry up they descend to lower levels where the flow is perennial. The water is mostly clear and bright in appearance but some of the accumulations are slightly milky in tint.

Springs—as such—with any bulk of water spouting forth in limited areas were not seen. The water appears first in drops or minute trickles accumulating gradually till a minute flow is formed in the nullah bed.

This observation tallies with that of Captain Battye who stated to me that there are no definite or individual springs. The main Pinjaul-ka-nullah from which water is piped is made up of a ramification of small tributary nullahs each of which contributes its varying quota of water. The water from these tributary nullahs has no definite origin in particular springs, *e. g.*, as from rocks, and no measurements have been taken of these tributary nullahs.

In Bithu-ka-nullah the water has its source mainly in eight springs at the head of the nullah about 800 feet below the Hindustan-Tibet Road level and Captain Battye states that each of these sources consists of a large number of minute springs along the 8 main nullahs over a distance of two hundred yards.

From these naked eye observations and from a consideration of the fact that the average rainfall of 32 years in the pre-monsoon dry months of April and May for Simla gave—

April	...	...	3.14" and	...	3.7 days when rain fell.
May	...	...	3.76" and	...	5.9 ditto ditto.

It would seem that the source of the water is mainly a surface supply. That vast quantities of water are absorbed into the soil is evident from the experiments made in 1899 by Mr. H. C. Robertson, then Assistant Engineer, to see if it were possible to build a storage tank. The observations were in Chini-ka-teka and from August 20th to September 1st, 5.95 inches of rain fell, representing 11,156,250 gallons in the 3,600,000 square feet of the area, and 5.12 inches of the rainfall passed over the weir representing 5,708,578 gallons, the remainder representing 5,447,672 gallons presumably being absorbed in the soil.

From the 2nd September to 23rd, the skies were clear and soil comparatively dry and the small fall of 2.91 inches of rain came in short storms with intervals during which the ground dried. Only 1,584,526 gallons were gauged at the weir out of the 5,456,250 which fell. That is .29 of the rainfall passed over the weir, the remainder 3,871,724 gallons presumably being retained in dry ground.

Whatever the source of the water, whether surface or spring—where it issues, from the ground, a walk over the area, an inspection of the farms, observation of cattle, pasturage, crops, and residents, the entire absence of any conservancy arrangements, and a knowledge of the ordinary habits of the people, leave no doubt as to the possibility—nay, certainty—of contamination of the water by the time it reaches the intake pipes at Chair. This is self-evident and accepted.

R. A. NEEDHAM.

APPENDIX 3.

NOTE BY THE HON'BLE SURGEON GENERAL SIR PARDEY LUKIS, K.C.S.I., M.D, I.M.S., ON THE DESIRABILITY OF CONSERVATION IN GENERAL AND OF THE CHAIR AREA IN PARTICULAR AND REFERENCES TO THE FENTON COMMITTEE'S REPORT.

Anything I have to say will be from the point of view of the scientific aspect of the case. The question of engineering and finance I leave for discussion by the experts in those subjects.

I will deal first of all with the visit to Chair. I do not think it is necessary to go into the question as to whether or no we are dealing with deep springs, although personally I am convinced from what I saw when I went there and from reading Captain Needham's report on his visit to the area which you all have in annexures B* and C† that there can be no question that they are surface springs. Another point more-

* "General description of the Catchment area from which Chair water supply is derived" by Captain R. A. Needham, I.M.S.

† Note on the question of conservation of the new catchment area by Captain R. A. Needham, I.M.S.

over confirms me in this opinion. In the Orchards Committee's report, we are told that it is necessary to conserve the forest on the other side of the hill in order to retain the water and I cannot understand why we should have artesian springs on one slope and surface water only on the other. But in any case whether we are dealing with deep spring water or whether it is a question of surface water, there is ample evidence that the water is exposed to serious contamination after it has issued from the ground. In this connection I would call your attention to the enormous number of flies we saw there, which you can take as a fairly safe indication of contamination of the soil; and also to the fact that if the analyses, which we have seen, are reliable the water from this area is ten times more polluted at the intake than water from the old catchment area. If then, the water of the old catchment area is ten times purer than it is at Chair, this seems to me to be a very strong argument in favour of conservation.

There is another point I wish to bring to the notice of the Committee. It must be remembered that these analyses are merely proof of faecal contamination. They are not proof either of the presence or absence of disease germs. All you can say from these analyses is that there is a certain amount of contamination. It may be either animal or human. If you have a highly polluted water supply, your filters are a very thin line of defence. In connection

Extract from joint note dated 27th September 1913 recorded by Colonel Seton and Major Robertson.

with this I refer you to Appendix B (iii) of the Fenton Report, (page 13), especially to the last sentence and the following quotation from Sir Thomas Barclay when speaking of the purification of water by filtration, "at the best it must be regarded as an exceedingly thin line of defence, not to be depended upon as a safeguard against highly polluted waters." In this connection you have to consider the possibility of an outbreak of cholera in the Chair area and neighbourhood. Major Perry will tell you

Report on the outbreak of cholera in the Kotgarh Sub-tehsil of the Simla district and the neighbouring Native State territory in the latter half of 1910 by Major E. L. Perry, I.M.S.

presently about the outbreak of cholera that occurred in the Kotgarh sub-tehsil of the Simla district and I wish the Committee to realise that unless the Chair area is conserved there is nothing whatever to prevent the occurrence of a similar outbreak there. Should this occur, I do not believe that filters would be a sufficient safeguard for Simla. I do not think moreover it is a sound argument that because it has never happened before and that everything has gone on very well for so many years, it will always go on as satisfactorily in the future as it has done in the past. In that connection I should like to draw your attention to what happened in connection with plague. You remember that when plague first came to India in 1896 many people said that because plague

had existed for centuries in an endemic form in the Kumaon hills there was not the least likelihood that it would spread all over India and that if there had been any likelihood of such an occurrence, plague would be constantly among us. Experience has proved the fallacy of such an argument and I should be very sorry if a similar argument were used now.

Now let us turn to the Fenton Committee's report. I would like you to look first of all at paragraphs 5 (2) and 7. Take paragraph 5 sub-section 2. You will see that the contention of the Punjab Government and one upon which they based their recommendations, is that the contamination occurring during and after rainfall can be obviated by the expedient of shutting off the Jewell filters during and after showers. I think from what we have seen and heard at Chair you will agree that this contention does not carry us very far. There can be very little doubt to my mind, quite apart from showers and rainfall, that the water at the intake at Chair is constantly polluted to a considerable extent, and for that reason I consider that the proposals to arrange to cut off the supply whenever you get excessive rainfall are absolutely unreliable—not to say, dangerous.

Now please turn to paragraph 8 of the first Fenton Report. Here you will find two distinct errors as regards matters of fact—(1) as regards the upper gravitation line, they state that the unfiltered water is passed through roughing filters direct to the consumer. Now the water from the upper area does *not* pass direct to the consumer: it is carefully sand-filtered at Dhali. This statement indicates a want of knowledge of the position. (2) As regards the lower gravitation line, it is stated that all the streams are polluted and give positive results in 1 c. c., also that the system of filtration is very imperfect. On the other hand if you turn to the report of the Orchards Committee and look at the analyses given on pages 8 and 9 you will find that a considerable number of these streams give "negative results" in 1 c. c. Here then you have analyses which contradict the above statement.

I wish also to draw attention to one other matter in connection with the report of the Orchards Committee. Please refer to the Government letter No. 294 (Revenue and Agriculture), dated 25th November 1912, where it is stated that the elaborate conservation of the source of supply can hardly be necessary in the face of *the admitted efficiency of the existing filters of the Cherot area*. This does not agree with Colonel Browning Smith's note on the sanitation of Simla in which he states that "the filtration of the old supply is imperfect."

Letter No. 31-2800, dated 28th April 1914.

The filters are efficient but over-worked. They work at the high rate of 90 gallons per square foot per diem against the usual average maximum of 50 gallons.

I might here explain to the Committee in answer to inquiries as to the meaning of the terms acid and gas. Organisms of faecal origin have the power of breaking up certain sugars and in so doing they produce both acid and gas, which can be detected, the acid by its reaction on litmus and the gas by means of a little inverted glass tube into which any gas will rise as it is produced. You begin with adding 1 c. c., of the suspected water, say about 8 drops, to your solution of sugar in a test tube. And you continue to add larger and larger quantities to a series of test tubes until you get a test tube in which the litmus turns red and you have gas formed in your inverted tube. The less water added before obtaining a reaction the more polluted is the water under examination, but it is merely an indication of the presence of faecal organisms. It is no proof of the presence or absence of disease-producing germs. There is no such thing as a definite bacteriological standard. It would vary with the source of the water and the nature of the contamination, *i.e.*,—whether human or animal, or whether merely with normal excreta or those containing disease germs.

Now please turn to paragraph 9 of the first Fenton Report—in which it is stated that “the new supply from the Chair filters will be at any rate as good and in all probability a much purer supply than the old.” I should like to say that there is absolutely no evidence to support that statement.

I would like you now to look at annexure B (i) paragraph 2. Here in paragraph 2, Mr. Aikman argues on the analogy of the Thames Valley. You cannot compare the Thames or any large river with a small hill stream. We all know that large rivers, both at home and in India very quickly destroy disease germs. This is particularly true as regards the Jumna. But the essential condition is a large mass of water with many miles of waterway. And even in such cases, as Mr. Aikman himself admits, all the sewage has to be treated and only the purified effluents allowed to reach the river.

The next point to which I wish to draw attention is in annexure B (ii) (*i.e.*, Colonel Browning Smith's note). There is the following statement in the last sentence“considering the Chair filters are 12 miles from Simla and therefore difficult to control I think the selection of the Jewell system to be a wise one, for such filters are easily worked and there is much less liability to error than in the case of slow sand filters which require the most constant care and scientific attention for success.”

I think the conclusion we arrived at was exactly the reverse to this. As a matter of fact the sand filters are more easily handled—there is less allowance for the personal equation than in the case of the Jewell filters. I should like in this connection to say that there is a note by Major Robertson in which he

Demi-official to Major Needham.

details certain experiences of his at Naini Tal which will show you that the personal equation has to be rather carefully considered in connection with Jewell filters. We come next to annexure B (iii). Here again you find the remark about filtration being an exceedingly thin line of defence. I want you to consider that very carefully in connection with Colonel Browning

No. 31-2800, dated 28th April 1914.

Smith's note, paragraph 6, in his last report on the sanitation of Simla. I also want you to consider paragraphs 3 and 4 of the Punjab Government's letter of the 15th May. The first point is as regards Colonel Browning Smith's note above quoted. I wish to point out, subject to anything the Health Officer and the Sanitary Commissioner may have to say on the subject, that this 10 c. c. must be regarded as a very arbitrary limit. There are many factors you have to consider and especially the factor of which I spoke just now as to the possibility of the importation of disease germs. The 10 c. c. limit may be perfectly safe if you have no disease germs coming on to your filters but personally I should not be inclined to regard 10 c.c. as a safe limit if there were actual contamination of the supply with disease-producing germs. There are other points with which Major Robertson has dealt in his letter. But the point I wish to draw your attention to is the statement that if you have this double system of filtration everything will be perfectly safe, and we need not conserve our area. All we have to do is to have this double line of filters and then Simla will be quite safe. If you look at this sketch plan of the water supply you will observe that if you accept this double line of defence, the people at Mashobra, Mabasu and above all the Viceroy at The Retreat will be getting water from a part which is behind the double line and only protected by a Jewell filter 13 miles away. You see that is a very important consideration which is completely slurred over in the Fenton Report. This brings us to the question of the concentration of filters, but before I have finished with the Fenton Report I would like to call your attention to certain matters noticed in Colonel Seton's and Major Robertson's note of dissent of the 25th March which is one of the annexures to the papers. I would like you to see first of all paragraph 5—*especially the italicised portion*—and paragraphs 8 and 13. You will see there how very strongly this question of pollution was brought before the Committee, you

will see moreover that, in spite of the representations of the Sanitary Commissioner with the Government of India, the Committee did not visit the area and lastly that the very excellent report on the Chair area written by Major Needham which was sent by him to Mr. Fenton was not placed before the Committee.

As regards the extension of the filtering area, I wish to point out (1) that it is absolutely essential that there should be an extension of the filtering area where filters are working at nearly double the usual maximum rates. (2) That it is sound policy to concentrate the filters at Dhali where they will be close at hand and under supervision. (3) As regards the type of filtration, that is a question to be considered from both the financial and the engineering point of view. Mechanical filters if they can be properly supervised are very good. But out here in India the personal equation is of importance—you have to be very careful—the Jewell filter, if it be not carefully watched may become extremely dangerous. In Major Robertson's letter he tells how on one occasion at Naini Tal he went out to see what was wrong and he found that the man in charge, in order to save trouble and also possibly to save expenditure, was not adding the alum. I need not point out that a Jewell filter where the alum has not been added would be an extremely dangerous one. On another occasion the filter was being "washed" with water from a condemned source of supply. Accidents of this kind must be guarded against in India.

Lastly, I think that the recommendation of the 1904 Committee ought to be carried out as regards taking water from Chair straight on to Dhali and that it should not be thrown into No. 17 stream as at present.

C. P. LUKIS.

APPENDIX 4.

NOTE BY MAJOR E. L. PERRY, I.M.S., ON THE OCCURRENCE OF CHOLERA
IN THE SIMLA HILL DISTRICTS WITH REFERENCE TO ITS POSSIBLE OCCUR-
RENCE IN THE CHAIR AREA IF IT WERE LEFT UNCONSERVED.

I will confine my remarks at present to the question of the risk of infection of the water supplies of the hills with cholera. The fact that cholera can infect water supplies is universally admitted. For instance we can quote the celebrated epidemic of cholera in London, in 1848, when the South London Waterworks were infected, and the more recent outbreak at Altona near Hamburg. In each of these cases it was accepted by the highest authorities that the water supplies had become infected with the germs of cholera. There is a somewhat important difference between the infection of water with the germs of cholera as compared with its infection with the germs of typhoid fever. In the case of cholera we have reason for believing that the organism is able to survive in the water for a very considerable period.

It is therefore desirable that we should know something concerning the frequency with which cholera occurs in the Simla hills and the habits and customs of the people of these hills when it does break out amongst them. Since 1902, I have personally dealt with cholera in a great many places in the neighbourhood of Simla. I first saw cholera near the Koti tunnel which is between Kalka and Dharmpur. On that occasion a small hill stream became infected. I have seen cholera at Dharmpur. I have seen a severe outbreak in some villages between Solan and Sabathu. I have seen cases at Tara Devi, Boileauganj and Kasumpti. All these were seen by me between 1902 and 1904. I will now deal with what was a very widespread outbreak of cholera in the Simla hills, in the neighbourhood of Kotgarh in the latter part of 1910. Copies of the report I then wrote are in the hands of the members of the Committee. At that time I personally verified over 99 cases and 50 deaths, but there were in the course of the outbreak a very great many cases which I did not verify. Probably the total mortality at that time amounted to between two and three hundred deaths. I spent many weeks dealing with that outbreak and I saw a great deal of what the people did. The people who live in those parts of the hills, which are for a period of every year under snow, are invariably exceedingly dirty in all their habits. We know that the Chair catchment area is at times under snow and we know also that the people who live upon it differ in no way from those whom I studied during the cholera epidemic of 1910. One custom these people have is that of turning persons, suffering from cholera, out of their villages. I have seen whole families thus turned out and of course the first thing they do is to camp by the side of some stream and when they do so, their entire excreta are passed practically directly into the stream. Another most dangerous custom common to all these hill people is that in all cases of death from cholera they put the corpses into the streams. They either throw them into the stream or they bury them lightly in the sand by the stream and when a little freshet of rain comes down the corpses are exposed and washed away. If they wash themselves or their clothes they naturally wash in the stream. I think there is no question that these small streams when they are running with but little water in them can become very seriously infected and that such infection could pass on to a filter bed. If such infection passed on to a filter bed there is strong reason to suppose that the organisms of cholera would pass through it to the consumer. It is not considered that any filter bed however efficient can be guaranteed to stop the organisms of cholera or of enteric fever passing through to the consumer if such organisms are present in any numbers. Houston holds the opinion that in the case of a typhoid carrier passing large quantities of typhoid bacteria in his urine, micturating into a river above an intake the bacteria would be carried directly on to the filters and would cause a serious outbreak amongst the people consuming the water after filtration. Houston's actual words are:—"If a typhoid carrier micturated in the river above the intakes (say from a boat) the typhoid germs, in the absence of a storage, would be carried directly on to the filters, with consequences which *could hardly*

be other than calamitous." (Houston—Studies in Water Supply, Macmillan and Co., 1913, page 105). Something of that nature occurred in the Maidstone epidemic. It originated from one case of enteric fever. But what I have quoted to you is the actual opinion of Houston who knows as much as anybody concerning the possibilities of sand filtration or any other form of filtration. He maintains that if a typhoid carrier were to urinate on or near a filter bed he would not be responsible for the filter bed holding back the organism. We may say that if the people living in the neighbouring villages did get cholera there would always be the danger. No responsible person would guarantee that the filter beds would not become infected and would not pass the organisms on to the consumer.

We admit that the minimum daily supply from these two nullahs in the dry season of the year is 400,000 gallons. That is a very small quantity of water and when we remember that this is in two separate nullahs we can realise how very readily disease organisms were they placed in such small streams could reach the filters. We get 200,000 gallons in each nullah—that is really a very small quantity of water, and the possibility of infecting that water by putting a cholera corpse into it, by passing choleraic excreta into it or by washing clothes of a cholera patient in it is certainly very great. It is quite different to the prospect of infecting the Sutlej or the Jumna. When you put a corpse into such a small quantity of water as is in a stream yielding only 200,000 gallons per diem the danger is very great. There were cases in which corpses had been buried in the side of a stream practically identical with these streams at Chair. They put these corpses there because they hope they will subsequently be washed down. It is a well-known fact that people in the hills constantly do it in the case of cholera deaths. Major Robertson says he also is familiar with this custom amongst hill people. It would be quite possible for people to wash clothes in the streams. That is why standards of water purity are exceedingly unsound things to rely upon too much. I consider we should be in a position to prevent people from getting on to our catchment area. I never considered at the time I wrote the 1910 report that we should ever allow people to live in the catchment area.

E. L. PERRY.

APPENDIX 5.

NOTE BY CAPTAIN A. D. STEWART, M.B., I.M.S., ON THE COMPARISON OF THE BACTERIOLOGICAL EXAMINATIONS OF THE UNCONSERVED CHAIR WATER AND THE WATER IN THE OLD CATCHMENT AREA (PARTIALLY CONSERVED.)

The following results are a resumé of the water analyses done during the last 3 years of the Chair water, the upper and lower gravitation, and Cherot supplies with the idea of instituting a comparison of the Chair supply (unconserved) and the other areas (conserved).

The Chair water has been examined 45 times.

On 23 occasions it has shown evidence of bacteriological impurity in ...	1 c.c.
On 37 occasions in	5 c. c.
On practically every occasion in	1 c. c.

These examinations were of the water collected just before it is led to the filter at Chair. The suitable waters in the conserved area for comparison are :—

1. The mixed unfiltered water of the upper gravitation supply at Dhali.
2. The mixed unfiltered water of the lower gravitation supply.
3. The unfiltered water of Cherot Nullah.

Taking these *seriatim* :—

1 has been examined 39 times. On all these occasions this water has never shown evidence of bacteriological impurity in 5 c. c. but has shown it in 10 c. c. at all times.

2 has been examined 42 times with the following results :—

always	+	in 10 c. c.
24 times	+	in 5 c. c.
7	„	+ in 1 c. c.
3	„	+ in 5 c. c.

+ = evidence of bacteriological impurity.

3.—Cherot Nullah.

Has been examined 43 times with the following results :—

always	+	in 10 c. c.
17 times	+	in 5 c. c.
7	„	+ in 1 c. c.
3	„	+ in 5 c. c.

The supply has since 10th April 1913 always given a negative result in 5 c. c.

It is very difficult to strike averages for these results but it may be stated that —

1. The mixed unfiltered supplies from upper and lower catchment areas and Cherot Nullah have never shown evidence in 1 c. c. compared with 23 times shown in the Chair supply out of 45 examinations.
2. That they have out of $(39+42+43)=124$ examinations shown positive evidence 6 times only in 5 c. c. as compared with positive evidence shown 37 times out of 43 examinations of the Chair water in 5 c. c.
3. That the Chair water always shows positive evidence in 1 c. c. whereas the mixed unfiltered waters of the other supplies have shown such evidence only on 14 occasions, out of 124 examinations.

A. D. STEWART.

APPENDIX 6.*Estimates for fencing Chair Catchment Area.*

The length of the boundaries of the Catchment area is approximately twelve miles including the two sides of the Hindustan-Tibet Road.

The cheapest form of fence from the point of view of first cost only would be one with wooden (Deodar) posts and three lines of wire. The first cost would be Rs. 1,350 a mile or say Rs. 17,000 for the whole area including gates.

The posts would however have to be renewed at intervals of say ten years and they should be coal-tarred once a year. The cost of annual upkeep would be about Rs. 1,600 which capitalised @ 4% is Rs. 40,000 so that the total cost may be said to be Rs. 17,000 + Rs. 40,000 = Rs. 57,000.

The next cheapest would be one with iron posts and three lines of wire. The first cost would be Rs. 1,750 a mile or say Rs. 21,800 for the whole area including gates.

The iron posts would have to be renewed at intervals of say thirty years and they should be painted once a year. The cost of annual upkeep would be about Rs. 1,000 which capitalised @ 4% is Rs. 25,000, so that total cost may be said to be Rs. 25,000 = Rs. 21,800 + Rs. 46,800.

Instead of wood or iron uprights reinforced concrete posts could be used. The first cost would be Rs. 2,200 a mile with three lines of wire or say Rs. 27,000 for the whole area including gates. These posts are practically everlasting and need not be painted at all, hence their first cost would be their only cost.

A. R. ASTBURY, *Executive Engineer,*
Simla Provincial Division.

APPENDIX 7.

TERMS OF ACQUISITION OF THE OLD CATCHMENT AREA FROM THE RANA OF KOTI.

Copy of paragraph 3 from a letter No. 38-S., dated 13th June 1887, from the Junior Secretary to Government of Punjab and its dependencies, to the Commissioner and Superintendent, Delhi Division.

3. No formal deed of lease between the Rana and the Government has been drawn up, and the terms of the arrangement are to be gathered from the Rubkar of the Superintendent, dated 2nd November 1877, and the Rana's reply of the 27th of the same month. Translations of these documents are herewith enclosed for communication to the Committee. The Lieutenant-Governor considers—and he feels no doubt the Committee will here agree with him—that, unless the party in possession or lessee is prepared to have the terms of the lease precisely defined or formally modified by negotiation with the Rana, great care should be taken not to exercise any power not clearly given by the lease. In regard to felling of trees, the understanding seems to have been that the Rana was not to make any claim if Government cut a few trees to supply any Government requirements in the way of timber, and that as there was no intention to fell for sale, no claim would arise on that account. This is a very vague and hardly practicable arrangement, and the assignment of the charge of the land to the Municipality makes it more difficult to interpret the right of felling reserved to Government. The Lieutenant-Governor thinks it very necessary to concede to the Rana that in the future if any living trees are felled and sold, half the proceeds, after deducting expenses, will be credited to him. Also that if any trees are felled by the Municipality, not merely for local use in the catchment area, but for use in Municipal Public Works in Simla, such trees should be treated as sold and half net value credited to the Rana. As, however, the area is reserved for forest growth to protect the water-springs there should be no fellings except such as are required to improve the forest growth. The felling which took place in a 5-acre patch for orchard purposes was disapproved by the Committee, and calls for no further remarks.

Copy.

Translation of a rubakar, dated 2nd November 1877, issued from the Court of Captain R. P. Nisbet, Superintendent of Simla Hill States.

Undersigned is pleased to direct that the Tika Sahib of Koti be informed that the area of the land situated within his territory which it is proposed to acquire for the water supply is 1,435 acres, and that all his claims with reference to the income of the land (so acquired), both cultivated and waste, together with the timber, fuel, fodder and fruit trees thereon have been fully considered and that it has been determined to allow to him the sum of Rs. 2,200 per annum, *i.e.*, Rs. 1,100 on the 30th of April and Rs. 1,100 on the 31st of October of each year, for such period as the land may be required by Government. Notice is hereby given that trees will be cut for Government purposes as may be necessary, but it is not the intention of Government to sell them. On the Tika Sahib's communicating his acceptance (of these conditions) a formal deed will be drawn up.

Copy.

Translation of a certified copy of a letter, dated 27th November 1877, from Bishan Chand of Koti, to Captain R. P. Nisbet, Deputy Commissioner and Superintendent of Simla Hill States.

After salutations.—I beg to acknowledge with gratification the receipt of your kind letter, dated 2nd November 1877, in which you say that the area of

the land situated in my territory which it is proposed to acquire for the water supply is 1,435 acres, and announce that in lieu of the income derived by me from the land and forests and timber, fuel, grass, etc., etc., the sum of Rs. 2,200 will be given, that is, Rs. 1,100 on the 30th of April, and Rs. 1,100 on the 31st of October each year, and request that my acceptance (of the proposal) be communicated to you. I consider that in proposing to give me Rs. 2,200 yearly you have treated me with much favour and consideration, but my real object was to obtain an exchange of land, my own territory being of limited extent. However, it appears that it is not the intention of the Government to arrange an exchange of territory. I and my ancestors have for ages been well-wishers and obedient servants of your exalted Government, and I do not now refuse to obey its behests, but on the present occasion some consideration ought to be shown by your all-powerful Government. I therefore make a humble representation to your honour that after due consideration you may pass some order favourable to me. Finis. Salutations. Dated the 27th November 1877.

The petition of Tika Bishan Chand, Ruler of the Koti State.

APPENDIX 8.

NOTE BY THE HON'BLE MR. M. NETHERSOLE, C.S.I., ON MECHANICAL FILTRATION AT NAINI TAL.

Before going up to Naini Tal I notified Colonel Harriss that I was coming and he very kindly got the information they had ready for me. I met him with Major Gratton and Captain Giles who have been connected with Naini water works for some years and know all about it. At the water works I inspected the Jewell filter and examined their records of bacteriological tests. When they put their Jewell filter down they began to take these observations and in a short time they discovered that many of their tests gave more bacteria after the water had passed through the filter than it had done before it went through the filter. The filter had fouled and the only reason which could be assigned for that was that the water at Naini Tal is so clear before it goes to the filter, that there is nothing to form the filter film—i.e., the film on the top of the sand—and the filtration through the sand in the Jewell being very much more rapid than in ordinary sand filters, they had been unable to suggest any remedy for it.

These were only isolated examples. They were not by any means common, but still there they were, and the general result was that there were very few cases where there was any improvement and there were these cases of decided non-improvement. So they had the filter out of action for some 18 months. Then they got up an expert to look at it—a man who had not been representing the Jewell Filter Company, and his report on it was to the effect that the firm he represented had something very much better and that if he were allowed he would give a guarantee that if the Municipal Committee would hand over the thing to them and allow them to put in a supplementary plant which was going to cost something like Rs. 8,000 that they would make it good and if they did not do what they said they would do, that is, improve and make the filtering perfect they would remove all their plant and charge nothing for the experiment. They then wrote to the people who put up the Jewell filter for them, Simpson & Company of Calcutta, who did not agree with the other expert's criticism, and said that they would send up their own expert who was arriving in Naini Tal the day I left. But I understood that it would take him at least a month to thoroughly investigate the matter.

All three of the sanitary medical officers who met me there were unanimous in their opinion that Jewell filters for a hill station where you have generally a very clear water to deal with were unsuitable. They said, however, that they could not give a final opinion till Simpson & Company had done all they could to improve it, and they very kindly promised to let us know the result.

On the information we have at present the Jewell filter appears to be unsatisfactory and when the water is too clear or when it is too dirty. My own opinion is that we should be very ill-advised to go in for Jewell filters here as against sand filters taking all the circumstances into consideration.

M. NETHERSOLE.

APPENDIX 9.

SIMLA WATER SUPPLY SYSTEM.

Note by Engineer in charge.

It is unnecessary to go into the earlier history of the water-works, as the 1904 Water Works Committee Report gives ample information on the subject, and in the 10 years' interval nothing important has occurred beyond the partial completion of the Chair scheme water from which has just been brought into Simla.

There has been some increase in the consumption due to the natural evolution of the town and the demand for better facilities for obtaining water and improved sanitary arrangements, but as far as possible projects likely to lead to more water being used have been held back, pending completion of the Chair extension.

Every effort has been used to keep down waste and leakage, and probably Simla is the only town in India where not only every private connection is metered, but many of the branch mains also, and in addition to this the whole distribution service is controlled by an elaborate system of waste recording meters and valves.

The water-supply works may be divided into two portions, *i.e.* —

1. Supply from the Catchments.
2. Distribution from the Reservoirs.

In its connection with the Simla Improvement Committee the supply is by far the more important; the distribution merely requiring certain extensions about which there is nothing controversial and which are treated in detail separately and beyond including the cost in this note they will not be alluded to.

The supply is now drawn from three sources *viz* :—

- (1) Cherat Nullah Pumps—taking water from Cherat Nullah and Lower Gravitation Line.
- (2) Upper Gravitation Line.
- (3) Chair Pumps.

The defects in the supply are those :—

- (A) Of quantity.
- (B) Of quality,
- (C) Mechanical.

In order to judge of (A) (sufficiency of the supply) it is necessary to consider the average daily supply and consumption during the period when the supply is at its minimum and consumption at its maximum.

This period is during the months of May and June (alluded to hereafter as the hot weather period) and the figures must be based on a dry year.

The worst year on record for supply is 1903 and the supply figures quoted by the 1904 Committee may be accepted.

The minimum *supply* then from the old sources may safely be placed at :—

				Gallons daily.
From Upper Gravitation Line	...	...	...	40,000
„ Cherat Pumps	...	...	...	290,000
„ Reservoirs	...	...	...	50,000
			Total	...
				380,000
To this must be added Chair	...	...	...	300,000
			Total	...
				680,000

Although, it is not possible at present to bring in the full quantity from Chair, owing to the pipes being too small, it is presumed this obstacle will soon be removed, and for the purpose of comparison between supply and demand the full 300,000 gallons is reckoned on.

As regards *consumption*, the first thing to estimate is what it would be in a dry year with the distribution system as it now stands (*i.e.*, before any more taps or pipes have been fixed).

In 1912, which was fairly hot and dry in May and June, the consumption reached the highest figure yet recorded, *viz.*, 450,000 gallons daily during the two months or about 11 gallons per head.

Since then numerous extensions have been made (though consumption caused thereby has been balanced to some extent by using oil on roads instead of water) and it is safe to infer that if the hot weather period of 1914 was very dry the consumption would now be about 480,000 gallons daily.

The future *consumption* then may be estimated as follows :—

		Gallons daily.
Present consumption in dry hot weather period	...	480,000
<i>Additional requirements—</i>		
(1) Increasing free allowances by 25 per cent	...	50,000
(2) Flushing public latrines	...	40,000
(3) For sewage connections on private estates	...	30,000
(4) Dhobi Ghâts	...	50,000
(5) Flushing surface drains	...	10,000
(6) Latrines and water connections in Bazaar houses	...	15,000
(7) Mashobra	...	25,000
(8) Extensions outside present Municipal limits and to Jakko...	...	20,000
(9) New sewage extensions (for Pail Depots)	...	10,000
		<hr/>
Total	...	730,000
		<hr/>

From the supply total, however, must be deducted 50,000 gallons, being the amount derived from the Cherat supplementary Pump. The Catchment of this includes all the Pumping Station buildings, and the use of water has been unreservedly condemned by all sanitary authorities for years past.

This leaves a *supply* of 630,000 gallons daily against an estimated *consumption* of 730,000 gallons, *i.e.*, a deficit of 100,000.

However, when the present supply of 300,000 gallons from the Chair is available (say, in January 1916) some little time must elapse before the various sanitary and other arrangements have been made for its disposal.

This period will probably be after three or four years (say, January 1920) and then Chair must be extended to its final limits of 100,000 gallons extra making 400,000 in all.

The estimated supply and consumption will then just balance each other.

In the whole history of Simla, the water-supply has invariably lagged behind the needs of the station, resulting in a strangling of all important sanitary improvements and the imposition of a heavy charge on householders for water used in excess of free allowances, such charge not being primarily for revenue purposes, but in order to restrict the consumption and keep it within the limits of the supply.

Owing to these restrictions any table showing the growth of the consumption in the last 10 or 15 years is valueless in giving any insight into what

water will be required in the future, but in case it may be of interest the following table shows the consumption for the hot weather period during the last 13 years :—

	Gallons daily.			
1901...	296,000
1902...	293,600
1903...	328,000
1904...	306,000
1905...	361,000
1906...	385,000
1907...	348,000
1908...	381,000
1909...	400,000
1910...	402,000
1911...	420,000
1912...	451,000
*1913...	394,000

* Abnormally wet and cool.

The free allowances are based on the assessments and at present houses of certain rentals are unduly favoured.

The Municipal Committee have been waiting for the completion of the Chair scheme in order to revise the scale and increase the allowances by 25 per cent or more, and, at the same time, special allowance will be made for houses with sanitary arrangements using water.

Consideration should be given to the question of increasing the Chair supply *now*, as it is far better the water-supply should be in excess of the demand than below it, and the estimates for future requirements can but be approximate. It would also be well to consider where further supply is to come from.

B.—Defects of Quality.

The sanitary authorities maintain that the rate of filtration in the Filters at the Cherat, Lower Gravitation and Dhali is too high, and it undoubtedly exceeds that accepted as efficient in all modern water-works.

The Filters are the ordinary open sand beds and the maximum rate may occasionally be 100 to 110 gallons per square foot per 24 hours at Cherat and Lower Gravitation and 70 to 80 gallons at Dhali. The average rates are 80 to 100 for Cherat and Lower Gravitation and 50 to 60 for Dhali.

At Chair, the Filters have so far proved efficient, but the distance from Simla is too great for adequate supervision either by the Health Officer or the Water Works Engineer. Water from Chair, therefore, is now re-filtered at Dhali by a temporary make-shift.

The best solution of the question of filtration will be to instal a battery of extra filters at Dhali and re-filter the entire supply.

The filters should be of the Jewell type in preference to the open beds.

Balancing tanks will be necessary at the heads of the Cherat and Chair Rising Mains in order to equalise the flow over 24 hours.

C.—Mechanical Defects.

The principal mechanical defect is the smallness and unsuitability of the Mains through which it is proposed to bring 300,000 gallons from Chair.

The recommendation of the 1904 Water Works Committee was that the water from Chair should be brought right to Sanjauli Reservoir in a new Main laid for the purpose, and so much importance was attached to this point that the Committee passed the following severe stricture on General Beresford Lovett's scheme when criticising it. "The new supply Main instead of being taken to the Sanjauli Reservoir stops at the Toll Bar, a serious omission."

Notwithstanding this, the recommendation of the 1904 Committee has not been carried out, and the new pipe from Chair terminates at 17 Stream, and from thence the existing Mains have been looked to for carrying the water.

A new Main should be laid down as originally proposed, for the following reasons :—

A Section—17 Stream to Dhali—

- (1) In case of any breakdown of the Dhali Filters, it will be possible to take Chair filtered water into Simla without it having run through any unfiltered pipes.
- (5) The 5" and 6" Mains from 17 Stream can only carry Chair water in the hot weather, when Gravitation supply is low—should there be a breakdown at Cherat in the monsoon it would be impossible to indent on Chair for water, as the Gravitation supply would be taking the whole carrying capacity of the two Mains.

Similarly, in the spring or autumn it would be desirable to equalise the supply from the pumps at Chair and Cherat and save very long hours at the latter.

But the minimum quantity that can be obtained from Chair at slow speed is 97 gallons per minute, and there might only be room in the Mains for 50 or 60 gallons per minute.

It is obvious then that Chair should have its own Main for this Section, and a 6"-pipe should be laid down, which will carry 400,000 gallons in 24 hours.

B Section—Dhali to Sanjauli—

At present, there is a 6" Main from Dhali and it is connected to the 8" Main from Cherat at the Toll Bar, and from here the two Mains run side by side to Sanjauli.

The 8" by itself cannot carry the full discharge from Cherat, so the 6" has to carry part, in addition to the supply from Gravitation.

In the monsoon and early spring, these Mains with difficulty carry the combined supply.

If Cherat flow is spread out over 24 hours, as it will be with the new Filtration scheme, they will just suffice.

It is wrong to depend in any way on these Mains for Chair, as although a certain proportion of the Chair supply can be carried in the hot weather, still it is a great mistake to be handicapped by any seasonal limitation.

It should be possible to get a full supply from Chair at any time of the year, so that Reservoirs can be quickly replenished after any unusual draw off.

A new 7" Main will be required which will carry 400,000 gallons in 24 hours.

Minor mechanical defects are the need for a storage Reservoir for the Mashobra supply. The provision of a Balancing Tank to hold 100,000 gallons at the head of the Chair Rising Mains will supply the main deficiency in this respect, but another small Reservoir to hold 25,000 gallons should be built at Charabra, in case of accidents.

The question of re-filtering water for Mashobra can only be decided when the Chair Catchment conservation is settled, and the fact that any supply to

Mashobra during the winter months will be impossible, because of frost, should not be lost sight of.

Summary of proposals.

Description.	Approximate cost.
	Rs.
1. Jewell Filters at Dhali 	69,000
2. Balancing Tank at head of Cherat Rising Main—130,000 gallons ...	14,000
3. Balancing Tank at head of Chair Rising Main—100,000 gallons ...	13,500
4. A new 6" Main from 17 Stream to Dhali 	23,000
5. A new 7" Main from Dhali to Sanjauli 	35,000
6. A 25,000 gallons Reservoir at Mashobra 	2,500
7. Extensions of distribution system 	63,619

Rough estimates are attached, except for item 6, for which the sum shown is sufficient for present purposes.

SIMLA MUNICIPALITY;

The 14th May 1914.

}

W. E. BUCHANAN,

*Engineer in charge,
Water and Drainage Works.*

APPENDIX 10.**Proposals for new main for bringing Chair water from No. 17 Stream to Sanjauli.**

Submitted by Engineer in charge, Water and Drainage Works, Simla Municipality.

The recommendation of the 1904 Water Works Committee was that the water from Chair should be brought to Sanjauli in a new main laid for the purpose.

The idea was not carried out though, and the existing mains have been looked to for bringing the water from 17 Stream to Sanjauli.

I now propose that a new main shall be laid as shown in the original scheme, the following being my reasons :—

A. Section—17 Stream to Dhali.

- (1) The anomaly of running filtered water through unfiltered water pipes will be avoided.
- (2) The 5" and 6" mains from 17 Stream can only carry Chair water in the hot weather when gravitation supply is low—should there be a breakdown at Cherat say in the monsoon, it would be impossible to indent on Chair for water, as the gravitation supply would be taking the whole carrying capacity of the two mains.

I think it is clearly obvious then that Chair should have its own main for this section and this main should be large enough to carry 400,000 gallons in 24 hours—which is the maximum supply to be got from Chair—a 6" pipe would be required, which if "Mannesmann" would cost about Rs. 23,000, if cast iron about Rs. 31,000.

B. Section—Dhali to Sanjauli.

At present there is a 6" main from Dhali and it is connected to the 8" main from Cherat at the Toll Bar, and from here the 2 mains run side by side to Sanjauli.

The 8" by itself cannot carry the full discharge from Cherat, so the 6" has to carry part, in addition to supply from gravitation.

In the monsoon and early spring these mains with difficulty carry the supply from Cherat and gravitation.

If Cherat flow was spread out over 24 hours, they would just suffice.

It seems to me wrong, therefore, that we should in any way depend on these mains for Chair—as although a certain proportion of the Chair supply would be carried in the hot weather, still it is a pity to be handicapped by any seasonal limitation.

It should be possible to get a full supply from Chair at any time of the year—so that reservoirs could be quickly replenished after any unusual demand.

I, therefore, propose a new 7" main from Dhali, large enough to carry 400,000 gallons in 24 hours.

				Rs.
Rough cost of Mannesmann tubes	...	...	...	35,000
If Cast Iron	...	...	...	47,000

I should recommend Mannesmann tubes in both cases.

If Cherat discharge is not to be spread out over 24 hours (*vide* scheme for re-filtration discussed by Fenton Committee) then this new main should be 8"—costing—

				Rs.
If Mannesmann steel tubes	...	...	...	41,000
If Cast Iron	...	...	...	52,000

W. E. BUCHANAN, *Engineer,*

Water Works.

30th April 1914.

A SECTION.

Abstract of the rough estimate of a new 6" main from I7 Stream to Dhali.

Serial No.	Sub-heads	Quantity.	RATE.		Total.	Grand Total.
			At	Per		
1	6" Mannesmann tubes—laid and fixed complete	8,100 ft.	2-10	ft.	Rs. 21,262	Rs.
2	Valves, etc. ... ... ...	...	...	say	1,500	
					22,762	
					Say	23,000
<p><i>Note—</i></p> <p>If cast iron mains are laid down the cost is Rs. 31,000.</p>						

W. E. BUCHANAN, *Engineer,*
Water Works.

12th May 1914.
410DE

Abstract of the rough estimate of a new 7" main from Dhali to Sanjauli

Serial No.	Sub-heads.	Quantity.	RATE.		Total.	Grand Total.
			At	Per		
1	7" Mannesmann tubes--laid and fixed complete	10,000 ft.	3-4	ft.	Rs. 32,500	Rs.
2	Valves, etc. ... ... ...	...	...	...	2,500	
					35,000	35,000
<p><i>Note—</i></p> <p>(1) If cast iron mains are laid down the cost is Rs. 47,000.</p> <p>(2) If an 8" main is substituted for the 7" the cost is—</p> <p align="right">Rs.</p> <p>A. Mannesmann ... 41,000</p> <p>B. Cast Iron ... 52,000</p>						

W. E. BUCHANAN, *Engineer,*

12th May 1914.

Water Works.

APPENDIX 11.

Rough Estimate of proposed Filters, Dhali, ordinary sand beds.

Serial. No.	Sub-heads.	Quantity.	RATE.		Total.	Grand Total.
			At	Per		
		C. ft.	Rs.	A. P.	Rs.	
1	Excavation	486,000	15	0 0	thousand	7,290
2	Lime masonry	18,000	60	0 0	cent	10,800
3	Lime concrete	34,000	40	0 0	„	13,600
		S. ft.				
4	Cement plaster, $\frac{1}{2}$ inch	21,000	15	0 0	„	3,150
		C. ft.				
5	Fine sand	34,000	0	8 0	c.ft.	17,000
6	Coarse sand	10,000	0	10 0	„	6,250
7	Bujri	4,500	0	4 0	„	1,125
8	Cement pointing	5,200	10	0 0	cent.	520
9	Bricks	72,000	50	0 0	thousand	3,600
10	Railings	Job	...	...	...	1,000
11	Covers for filterwalls, etc.	Job	...	...	...	500
12	Dismantling and rebuilding huts	Job	...	...	...	700
13	Pipe work and valves—see details ... ..	...	...	...	...	16,000
14	Contingencies 5 per cent ... ..	...	...	...	...	...
	Total ... ..	...	...	..	..	85,610

W. E. BUCHANAN.

*Engineer-in-charge,
Water and Drainage Works,
Simla Municipality.*

Dated 11th September 1913.

Estimate for proposed Filters, Dhali, ordinary sand beds.

ITEMS OF WORK.				Number.	Length.	Breadth.	Depth.	Total.	Grand Total.
Lime Masonry—Side walls	2	176	3	7	7,392	17,976	
" "	...	...	2	82	3	7	3,444
Partition walls	...	...	1	172	3½	7	3,956
" "	...	...	1	80	3½	7	1,840
Valve pits	...	...	8	12	2	7	1,844
Lime Concrete—Floor	182	92	2	33,488	33,488	
Cement Plaster—¼" Walls	4	250	7	0	7,000	20,600	
Floor	...	...	4	85	40	0	13,600
Sand—Fine, and 25 per cent for washing	...	...	4	85	40	2½'	34,000
Coarse	4	85	40	¾'	10,200	34,000	
Bujri	4	85	40	½'	4,500	10,200	
								4,500	
Cement Pointing—Side walls	516	9	0	4,644	5,148	
Partition walls	...	...	...	252	2	0	504
			No.	No.	No.				
Bricks—Floor	4	113	106	0	47,912	No.	71,868
Channels	...	...	4	113	53	0	23,956
Excavation—Above top of walls of present filters	186	120	15	334,800	485,460	
Below present filters	...	...	...	186	90	9	150,660

Rough estimate of pipes for proposed ordinary sand filters, Dhali.

Serial No.	Sub-head.	Quantity.	Rate.		Total.	Grand Total.
			At	Per		
			Rs. A.		Rs.	Rs.
1	8-inch Pipes ...	300	32 0	each	9,600	
2	8 „ Bends ...	48	25 0	each	1,200	
3	8 „ Tees ...	13	30 0	each	390	
4	8 „ Valves ...	12	120 0	each	1,440	
5	8 „ Plug valves for outlets	4	100 0	each	400	
6	8 „ Bell mouths ...	12	20 0	each	240	
7	Laying ...	2,700 ft.	0 12	foot	2,000	
8	Fixing pipes and round filters	Job	...	...	200	
9	Ventilators ...	Job	...	...	200	
						15,670
						Say, 16,000

W. E. BUCHANAN,

*Engineer-in-charge,
Water and Drainage Works,
Simla Municipality.*

Dated 11th September 1913.

*Estimate for reservoir near Toll Bar, framed by Water-Works
Engineer, Simla.*

Detail of work.	No.	MEASUREMENTS.			Quantities.	
		L.	B.	H.		
<i>Reservoir near Toll Bar, 70' × 30' × 10½' inside.</i>		Feet.	Feet.	Feet.	C. ft.	C. ft.
1. Excavation ...	1	90	70	12	75,600	
						75,600
			Area.			
2. Stone in lime masonry walls ...	2	84	× 52½ sq. ft.		8,820	
Ditto ditto ...	2	30	× 52½ sq. ft.		3,150	
2 valve pits, walls ...	4	6	2	4	192	
Ditto ditto ...	4	2	2	4	64	
						12,226
3. 2' concrete in lime under floor and walls.	1	86	46	2	...	7,912
					sq. ft.	sq. ft.
4. (¼" thick) plaster walls ...	2	70	...	10½	1,470	
Ditto ditto ...	2	30	...	10½	630	
Floor ...	1	70	30	...	2,100	
On walls of valve pits ...	2	8	...	4	64	
						4,264 sq. ft.

Quantity or No.	Abstract of expense.	Rate.		Per	Amount.	Total.
		Rs.	A. P.		Rs.	Rs.
	Excavation, 75,600 c. ft. ...	15	0	0	thou- sand.	1,134
	Stone in lime, 12,300 c. ft. ...	60	0	0	cent.	7,380
	Concrete in lime, 8,000 c. ft. ...	40	0	0	„	3,200
	Cement plaster, 4,300 sq ft. ...	15	0	0	„	645
	Valves, etc., say ...	...	...	...	1,000	
	Contingencies at 5 per cent, say ...	...	...	...	641	14,000

APPENDIX 12.

Mashobra Water Supply.

In the estimate for "water-supply to Mashobra and The Retreat" amounting to Rs. 16,311 sanctioned in January 1913, the scheme has been calculated to supply :—

for Mashobra 20,000 gallons in a period of 19.5 hours.

„ The Retreat 800 „ „ 6.0 „

No filter beds or storage tanks are included in the estimate, the supply pipe taking direct off the Chair gravity main at Charabra (8,218). An 800 gallon tank was provided for The Retreat "to enable water to be supplied continually since this tank can only be filled during the six evening hours, while the Simla supply is cut off, owing to the fact that the hydraulic gradient at Charabra is too low to supply The Retreat when the flow to Simla exceeds 260,000 gallons in a day of 18 hours". The level of this tank is 8210.6.

The conditions of the Mashobra supply are peculiar. Mashobra and The Retreat need a continuous supply of water estimated at 20,800 gallons a day and this is to be obtained from a source which is discontinuous.

It seems essential that the Mashobra supply should be fortified by means of a storage reservoir which will contain sufficient water to tide over the maximum period during which the sources of supply are cut off.

It has been laid down that the Chair pumps are not to be worked while the water in the streams is turbid, but it is hardly possible yet to say how long a turbid condition may be maintained in the streams. On the data so far available it would seem unwise to allow less than five days' total storage capacity for the Mashobra supply.

If filter beds are provided it is necessary that a service reservoir should be provided between the filter and the consumer. The capacity of the service reservoir should not be less than two days' supply.

It is, therefore, suggested that the scheme at Mashobra should consist of—

- (1) A storage reservoir holding three days' supply $3 \times 20,800 = 62,400$ gallons.
- (2) A filter bed in two compartments having a total net filtering area of $20,800/50 = 416$ square feet.
- (3) A service reservoir holding two days' supply $2 \times 20,800 = 41,600$ gallons.

If the Mashobra supply is shut down in the winter months there will be no need to cover in any of these, but if it is to be continuous throughout the year the covering in of the filters at least would have to be considered.

Turning to the question of site. In the original Water Works extension scheme filter beds were proposed at Charabra where the keymen's hut has since been placed (see ferro-type plan of "Eastern site", right hand bottom corner).

The level of this site is 8,222. It is understood that this proposal was subsequently dropped when it was decided to have Jewell filters at Chair. By adhering to this site it will just be possible to command The Retreat tank and at the same time draw from the gravity main even while the supply to Simla is running. It will of course necessitate the demolition of the keymen's hut, but this is an inexpensive building and a site can be found for it elsewhere.

It should be mentioned that in the scheme now proposed margin of head for The Retreat supply is exceedingly small and it may be found in practice impossible to get the water as high as the second floor of The Retreat, but it should be sufficient to reach the first floor.

Mashobra Water Supply.

<i>Estimate.</i>	<i>Rate.</i>	<i>Rs.</i>
Storage reservoir to hold 62,400 gallons ...	... 100 Rs. per 100 gallons	6,240
Filter beds to give net filter area of 416 square feet ...	... 6.5 Rs. per square foot.	2,704
Service reservoir to hold 41,600 gallons ...	... 100 Rs. per 100 gallons	4,160
		<hr/>
		13,104
<i>Add for contingencies 5 per cent</i> ...		655
		<hr/>
		13,759
		Say 14,000

A. R. ASTBURY,
Engineer-in-charge, Water and Drainage Works,
Simla Municipality.

APPENDIX 13.**LIST OF PROJECTS SUBMITTED BY ENGINEER IN CHARGE,
WATER AND DRAINAGE WORKS, SIMLA MUNICIPALITY.**

1. Extension of Water Supply :—				Estimated cost.	
			Rs.		Rs.
Jakko (see file)	...	...	... 40,000		
Beyond Boileauganj		...	... 8,820		
Beyond Kasumpti	...	...	... 3,669		
Barari	...	...	... 7,540		
Cemetery	...	...	... 3,590		
					63,619
2. Conversion of Latrines				...	45,000
3. Extension of Sewage Mains :—					
Barari	...	...	... 28,000		
Boileauganj	...	...	... 25,000		
					53,000
4. Sewage and Water system for Nabha Estate				...	15,000
5. Conversion of Pail Depôts to the improved type, 26 Depôts remain				...	8,000
6. Provision of Pail Depôts and Sewage system for Sanjauli and Con-					
vent—Estimate prepared by Public Works Department, 5 years					
ago—Rs. 48,457—should now I think be increased by Rs. 5,000					
or say	...	...	...	...	53,500
7. Filters for Septic Tanks				...	20,000
			Total	...	2,58,119

1.—*Extension of the water-supply.*

The following is an abstract of cost for the extensions proposed :—

Abstract of cost—

					Rs.
I. Jakko	...	...	...	...	40,000
II. Boileauganj	...	...	...	...	8,820
III. Kasumpti	...	...	...	...	3,669
IV. Barari ...	..	...	...	...	7,540
V. Cemetery	...	...	...	...	3,590
			Total	...	63,619

I. *Jakko*.—This is to provide water for all houses on Jakko above the level of Corstorphan's Hotel—which is the highest point which water reaches at present.

This scheme was recommended by the 1907 Improvement Committee, paragraph 102.

II and III. *Beyond Boileauganj and Kasumpti*.—Both extensions recommended by 1907 Committee, paragraph 102; they will supply water to populous districts at present outside Municipal limits.

IV. *Barari village* (North of Petersfield).—This locality will be taken into Municipal limits soon, and water must be provided.

V. *Cemetery*.—This is an extension for the district between Milsington and old Brewery—as the result of numerous petitions for water.

W. E. BUCHANAN,

*Engineer in charge,
Water and Drainage Works,
Simla Municipality.*

12th May 1914.

I. JAKKO.

Abstract of the estimate of Water-supply extensions.

Serial Nos.	Sub-heads.	Quantity.	RATE.		Total.	Grand Total.
			@	Per		
					Rs.	
1	Pumping plant	...	...	...	12,894	
2	Piping	...	...	...	6,622	
3	Tanks and Buildings ...	...	...	...	4,827	
4	Distribution	...	...	...	15,000	
					39,343	
					Say ...	40,000
	For details see file with Public Works Department Estimate.					

II. BEYOND BOILEAUGANJ.

Abstract of the estimate of Water-supply extensions.

[illegible]

III. KASUMPTI.

Abstract of the estimate of Water-supply extensions.

Serial Nos.	Sub-heads.				Quantity.	RATE.		Total.	Grand Total.
						@	Per		
						Rs.		Rs.	Rs.
1	3" C. I. Piping	...	...	...	2,000ft.	1-8	feet	3,000	
2	3" „ Bends	...	...	...	12	6	each	72	
3	3" „ Tees	...	...	...	4	10	each	40	
4	3" Sluice valves	...	...	...	5	30	each	150	
5	Road boxes	...	...	...	5	6	each	30	
6	2½" Fire hydrants	...	...	...	3	22	each	66	
7	Road boxes	...	...	...	3	10	each	30	
8	Iron standpost	...	...	...	1	100	each	100	
9	3" collars	...	...	...	2	3	each	6	
								3,494	
	Contingencies	...	...	...	...	...	...	175	
								3,669	3,669

V. TOWARDS CEMETERY.

Abstract of the estimate of Water-supply extensions.

Serial Nos.	Sub-heads.			Quantity.	Rate.		Total.	Grand Total.
					@	Per		
					Rs. A. P.		Rs.	Rs.
1	3" C. I. Piping	...	...	600 feet	1 8 0	foot	900	
2	3" „ Bends	...	...	6	6 0 0	each	36	
3	3" „ Tees	...	...	5	10 0 0	„	50	
4	3" Sluice valves	...	...	3	30 0 0	„	90	
5	Road boxes	...	...	3	6 0 0	„	18	
6	2½" Fire hydrants	...	...	2	22 0 0	„	44	
7	Road boxes	...	...	2	10 0 0	„	20	
8	400 gallon tank	...	...	1	...	...	200	
9	200 „ „	...	...	2	100 0 0	each	200	
10	3" Ball valve	...	...	1	...	...	90	
11	1" „	...	...	2	10 0 0	each	20	
12	2" Piping, G. I.	...	...	1,000 feet	0 14 0	foot	875	
13	1" „	...	...	1,200 „	0 8 0	„	600	
14	2" valves	...	...	3	20 0 0	each	60	
15	1" „	...	...	5	7 0 0	„	35	
16	Road boxes	...	...	8	4 0 0	„	32	
17	Standpost, iron	...	...	1	...	...	100	
18	Small fittings	...	...	say	...	...	20	
19	Masonry	...	...	say	...	...	30	
							3,420	
Contingencies 5% ...							170	
							3,590	3,590

W. E. BUCHANAN, *Engineer,*

12th May 1914.

Water Works.

SIMLA SEWAGE SYSTEM.

Note by Engineer in charge.

The sewage of Simla is at present mainly disposed of by the agency of pail depôts (*i.e.* depôts to which the pails of night soil are carried).

At the depôts the soil is deposited into receptacles and carried away by flushing, through pipes, to the septic tanks at the outfalls.

There are 50 pail depôts, and they are divided among 5 districts, each district having its own septic tank.

In addition to the pail depôts there are a certain number of flush latrines, private and Municipal, and some 35 estates have their own sewage connections.

Sullage from the Bazaars is disposed of by catchpits and separating weirs, leading into the sewers.

Much has been done since 1907 towards increasing the efficiency of the sewage system.

The principal improvements being :—

1. Substitution of cast iron for stone ware pipes.
2. Re-grading or enlarging pipes liable to get choked.
3. Altering pail depôts to a better type.

At the same time continual experiment has been carried on with a view to discovering the best forms of latrines and catchpits.

Satisfactory types of each have now been evolved, and all catchpits will be remodelled shortly.

The difficulties to be dealt with in Simla owing to local customs and conditions are unique, and it has been found that all laws based on English practice as regards the self-cleansing capacity of sewers, are unreliable.

A plan is attached showing—

- (1) Sewage mains and outfalls as they existed in 1907.
- (2) The extensions of sewers laid (but from Municipal funds) in accordance with recommendation of 1907 Committee (paragraph 99).
- (3) The extensions laid since 1907 apart from this recommendation.
- (4) The sewers and pail depôts which it is proposed now to build and for which estimates and plans are attached, they are :—Barari, Boileau-ganj, Nabha Estate and Sanjauli-Convent.

The new sewers which are proposed are for specific districts, and it is not thought necessary at this stage to spend more money on extensions of existing mains.

With the extensions carried out since 1907, it is possible to connect up at least 100 estates, but more water is required before this can be done, and until the water-supply is put on a more satisfactory footing it is useless locking up more capital in sewage pipes doing nothing.

With regard to the accessories of the sewage works, *viz.*, latrines and pail depôts, it is proposed to convert 33 of the former to a flush type when water is available, and to rebuild 26 pail depôts to an improved pattern.

Detailed accounts of these proposals are attached.

Proposals are also attached for dealing with the effluent at the septic tanks.

W. E. BUCHANAN,

Engineer in charge, Water and Drainage Works.

Dated the 13th May 1914.

2.—*Conversion of Latrines.*

The 1907 Improvement Committee recommended that all public latrines should be converted to a flush type and connected to the sewage system but want of water has prevented any large number being so treated.

There are 72 Public Latrines, and of these 9 are already of the flush type.

Out of the balance of 63, 33 can be converted at reasonable cost. This includes all the important latrines, the remaining 30 being for the most part unimportant ones scattered about the station far from water or sewage mains.

The estimate is inclusive of the necessary extensions of sewers, and water pipes.

The cost estimated by the 1907 Committee, (Rs. 20,000) was very much under the mark.

Abstract of the estimate for converting all latrines within 300 feet of a sewer to flush latrines.

Serial Nos	Sub-heads			Quantity.	RATE.		Total	Grand Total
					@	Per		
	LOCALITY.						Rs.	
1	E. Elysium Hill	...	...	...	...	...	500	
2	Shankh Village	...	...	...	...	...	1,700	
3	Below the Oaks	...	...	...	...	...	1,000	
4	Lakkar Bazaar	...	...	...	...	...	2,000	
5	Below Post Office	...	...	...	...	...	1,000	
6	Coolie lines, Court Hill	...	...	...	...	...	500	
7	Below Firwood	...	...	...	...	...	500	
8	S. Jakko	...	...	...	...	...	1,200	
9	Below Newstead	...	...	...	...	...	900	
10	Jhampanies shed	...	...	...	...	...	800	
11	Near Juba House	...	...	...	...	...	600	
12	May Day Hill	...	...	...	...	...	1,000	
13	Chota Simla Bazaar	...	...	...	...	...	2,400	
14	„ „ School	...	...	...	...	...	500	
15	Kashmuri Mohalla	...	...	...	...	...	2,400	
16	Middle Bazaar	...	...	...	...	...	4,600	
17	Pahari Chakla	...	...	...	...	...	1,700	
18	Edwards Gunj	...	...	...	...	...	3,300	
19	Old Butcher Khana	...	...	...	...	...	2,000	
20	Above Police Station	...	...	...	...	...	1,500	
21	Below „ „	...	...	...	...	...	1,000	
22	„ „ „	...	...	...	...	...	600	
23	Sooji Lines	...	...	...	...	...	1,600	
24	Serai	...	...	...	...	...	2,400	
25	Singh Sabba	...	...	...	...	...	1,400	
26	Ladaki Mohalla	...	...	...	...	...	2,000	
27	Slaughter House	...	...	...	...	...	400	
28	Peons' quarters	...	...	...	...	...	600	
29	Below Railway Station	...	...	...	...	...	500	
30	Dhonidbar	...	...	...	...	...	600	
31	Boileauganj Mohalla	...	...	...	...	...	2,700	
32	Old Octroi Post	...	...	...	...	...	500	
33	Below Dunloe	...	...	...	...	...	600	
	Total	...	...	...	...	...	45,000	

3.—*Extension of Sewage Mains.*

(a) BARARI.

It is very difficult to find a suitable place for a septic tank for Barari.

The valleys to the west are all populous and highly cultivated, and it would be hard to select a site which would not be a general nuisance, besides polluting the water-supply in the nullahs.

I have therefore decided that the best plan will be to run a sewer down to the main nullah between Barari and Simla and from thence to the North Disposal Works.

The existing septic tank will be used—and should it at any future time require extending or enlarging there is ample ground for the purpose. A Pail Depôt will be built near Barari village.

Serial Nos	Sub-heads.	Quantity.	Rate.		Total.	Grand Total.
			@	Per		
1	4" Cast iron pipe laid and fixed complete including bends.	8,000 feet	Rs. 2 12	ft.	Rs. 22,000	Rs.
2	Bridges	Lump sum			700	
3	Compensation	do.			1,000	
4	Ventilators	16 No.	12	each.	192	
5	Pail Depôts complete	Job.			450	
6	4" C. I. tees	16 No.	15	"	240	
7	4" do. Inspection Junctions ...	6 "	28	"	168	
8	Retaining walls... ..	Lump sum			2,000	
	Total ... ..	...	...	...	26,750	
	Contingencies @ 5 % ... ..	...	...	...	1,337	
						28,087
					Say Rs.	28,000

Extension of Sewage Mains.

(b) BOILEAUGANJ.

There is a growing colony on and just beyond the Municipal Boundary S. W. of Boileauganj.

The nearest pail depôt is distant more than half a mile.

Owing to the configuration of the land and numerous intervening nullahs it is impossible to link up to the existing sewage system except at prohibitive expense. It will therefore be best to have another small septic tank installation in the Boileauganj ravine about $\frac{1}{2}$ a mile from Lalpani outfall.

There is a good site for a tank with plenty of water and the installation is not likely to be a nuisance or interfere to any appreciable extent with the rights of zemindars.

Abstract of the estimate of Sewer for locality beyond Boileauganj.

Serial Nos.	Sub-heads.	Quantity.	RATE.		Total.	Grand Total.
			@	Per		
1	4" Cast iron pipe laid and fixed complete including bends.	6,000 ft.	Rs. 2-12	ft.	Rs. 16,500	Rs.
2	Bridges	Lump sum			500	
3	Compensation	Do.			500	
4	Ventilators	12 No.	12	Each	144	
5	4" C. I. tees	12 "	15	"	180	
6	Pail Depôts complete	1 "			450	
7	4" C. I. Inspection Junctions	4 "	28	"	112	
8	Retaining walls	Lump sum			1,000	
9	Septic tank complete	Job			2,000	
10	Dilution pipes and dam	"			1,000	
11	Filtration	"			1,000	
12	Sweepers' quarters... ..	"			500	
					23,886	
	Contingencies @ 5 per cent. ...				1,194	
					25,080	
					Say	25,000

(4) *Sewage and Water system for Nabha Estate.*

The Nabha Estate is a small town in itself and adequate arrangements for supply of water, and disposal of sewage are imperative.

The Sanitary Commissioner has frequently called attention to this fact.

A pail depôt will be built on the southern border of the estate, and a 6" pipe led from thence to the 9" main sewer to Lalpani.

Abstract of the estimate of Water and Sewage main for Nabha Estate.

Serial Nos.	Sub-heads.	Quantity.	RATE.		Total.	Grand Total.
			@	Per		
	WATER.		Rs. A.		Rs.	Rs.
1	3" Cast iron pipe including bends laid complete ...	1,100 ft.	1 1	ft.	1,788	
2	3" Valves ...	3 No.	30	each	90	
3	B. P. Tank, 400 gallons ...	1 "	190	"	190	
4	Surface boxes ...	8 "	6	"	48	
5	Fire Hydrants ...	2 "	25	"	50	
6	2" G. I. Pipe ...	600 ft.	1 2	ft.	675	
7	2" Valves ...	3 No.	20	each	60	
8	1" G. I. Pipe ...	200 ft.	0 9	ft.	112	
9	1" Valves ...	2 No.	7	each	14	
10	Fittings ...	Lump sum.			20	
11	3" C. I. tees ...	4 No.	8	each	32	
					3,079	
	Contingencies @ 5 per cent ...	...	...	...	154	} 3,233
	SEWAGE.					
1	Pail Depôt complete ...	1 No.	...	...	450	
2	6" Cast iron pipe ...	2,700 ft.	3 8	ft.	9,450	
3	9" x 6" Cast iron junction ...	1 No.	40 0	each	40	
4	Ventilators shafts ...	6 "	20 0	"	120	
5	6" x 4" Cast iron tees ...	6 "	20 0	"	120	
6	Bridge ...	...	Job.	...	200	
7	Retaining and stop walls ...	Lump sum			500	
8	Compensation ...	...	...	...	300	
					11,180	
	Contingencies @ 5 per cent ...	...	...	...	559	
					11,739	11,739
						14,972
					Say	15,000

(5) *Conversion of Pail Depôts to the improved type.*

The improved type is that designed by the Drainage Works Engineer, and it has been approved by many Sanitary Authorities.

Twenty-six depôts remain to be converted.

Abstract of the estimate of converting old Pail Depôts to new pattern.

Serial No.	Sub-heads.	Quantity.	RATE.		Total.
			@	Per	
1	Pail Depôts	26 No.	Rs. 300	each	Rs. 7,800
					Say

(6) *Provision of Pail Depôts and Sewage system for Sanjauli and Convent.*

This was recommended by the 1907 Committee (paragraph 98-C.). The estimate has been prepared by the Public Works Department.

See file on the subject for details—for copy of estimate see below.

Abstract of the estimate of Convent and Sanjauli Sewage Disposal Works.

Serial Nos.	Sub-heads.	Quantity.	RATE.		Total.	Grand Total.
			@	Per		
			Rs. A.		Rs.	Rs.
1	4" C. I. pipe	10,205 ft.	2 0	ft.	20,410	
2	3" Do.	500	1 4	ft.	665	
3	Masonry works complete			Job	400	
4	Pail depôts	2	450	each	900	
5	Septic tank 40' x 40'			Job	7,500	
6	Treckling ballasts filter			Job	4,000	
7	Compensation to Sarala Village			Job	1,000	
8	Bridges	3	500	each	1,500	36,375
...	Contingencies and petty establishment @ 7 per cent.	...			...	2,546
						38,921
...	Establishment charges @ 23 per cent ... ..	...	...	...	...	8,952
...	Tools and Plants @ 1-8 per cent ... ..	...	...	...	...	584
						48,457
...	For plan and details see estimate prepared by Public Works Department.	...				

(7) Filters for Septic Tanks.

The 1907 Committee recommended that filters should be provided for Northern and Western outfalls and allotted a sum of Rs. 15,000.

In 1910 an estimate for Rs. 19,052 was prepared by the Public Works Department for a slate bed filter at the Northern Outfall.

The Sanitary Commissioner, and the Sanitary Engineer and the Municipal Committee, were unanimous though in agreeing that simpler and less expensive measures would answer the purpose.

The project was therefore abandoned, and arrangements made at all five septic tanks to purify the effluent by running it over the hill sides.

This has been done with a fair measure of success, except at Lalpani, where the ground is steep and rocky and ill-adapted for such filtering.

It is therefore proposed to make some simple experimental filters, at this outfall and on the success of these will depend the installation of similar filters at the other outfalls.

But it is absolutely necessary that these filters should be automatic and require no attention as in these isolated places far from supervision it is quite impossible to get sweepers to exercise any intelligence, or carry out duties of any sort with any degree of efficiency.

The proposed filter will take the form of layers of ballast 1 foot or more in thickness spread over the hill sides so that there is continual filtration. The cost and the exact method of arranging the beds and distributing the effluent, can only be found by experiment, and as soon as certain land has been acquired work will be started.

It is not thought that more than Rs. 20,000 will be required.

APPENDIX 14.

On the carrying capacity of the Sewage Mains of Simla, with detailed estimates for converting the remaining 30 Public Latrines to the Flush system.

The Simla sewage system as it now stands does not represent the outcome of one original comprehensive scheme, but of four main schemes. As the matter is of great importance in considering further developments, the technical history of the sewage system may be outlined.

- (1) *Mr. Parkes' scheme*—Laying 9" mains from the Main, Boileauganj, and Chota Simla bazars, to the 3rd water-fall—*completed 1886*, (but for want of funds carried only from Main bazaar to 1st water-fall).
- (2) *Simla Sewage Extension project*—Laying 9" mains from Boileauganj and Chota Simla to join Mr. Parkes' main at the 1st water-fall and a 9" extension from there to the 3rd water-fall—*completed 1893*.
- (3) *Simla bazaar sullage project*—Laying surface street drains, and surface intercepting drains, ending at catchpits, and taking sullage into the sewage system and turning flood water into the nullahs—*completed 1904*.
- (4) *Simla Sewage Extension Project*—The provision of additional mains, and construction of disposal works at 5 points—*completed 1908*.

In Mr. Parkes' scheme there was no provision for purifying the effluent, which was to be discharged direct into the ravine. The 9" pipe then laid down is still the main outfall on the South side of Simla. Mr. Parkes' scheme originally provided for 6" mains and the calculations contained in his report show that the principle was accepted of running the mains full bore. Break pressure tanks were provided (referred to in Mr. Nethersole's note as balance tanks) at 459' vertical intervals which served also the purposes of ventilation and flushing.

The "daily quantity of sewage, night-soil and flushing water" was estimated at 10,000 gallons a day, but although the calculations showed that a 6" pipe at a gradient of $\frac{1}{10}$ would carry nearly 1,000 gallons a minute, this size was taken in the project to avoid the danger of the pipe getting choked with rags, straw, etc. The Municipal Committee of Simla, however, considered that a 6" pipe was dangerously small and preferred to bear the extra expense of a 9" pipe.

It will be seen that the 9" main was designed entirely without reference to the existing terminal works, and that the size was determined on an arbitrary basis more by the fear of chokage than by any calculations of the quantity of sewage likely to be received and the carrying capacity of the pipes. In 1891 the Simla Municipal Committee extended the 9" main from the 1st to the 2nd water-fall, and Mr. Younghusband prepared a project for completing Mr. Parkes' original scheme, No. (2) above. Mr. Younghusband gave with his project a calculation showing the discharge of a 9" pipe having a slope of 6.38' in 1,000 as 2,115 gallons a minute. The formula he used was—

Discharge = $293.7286 d^2 (140\sqrt{r.s} - 11\sqrt[3]{r.s})$ apparently Neville's formula, and it is evident that the principle was again accepted that the sewers might run full bore between the break-pressure tanks.

Mr. Goument carried out the work, but under proper authority, made during execution an important modification by omitting the break pressure tanks. It was agreed that all the purposes served by these tanks could be better and cheaper achieved by simple vertical open-stand pipes at more frequent intervals, and it was stated that the sewer worked as a duct and not under pressure.

In 1902 the Simla bazaar sullage project was sanctioned. By this scheme the waste-water from bazars together with a certain quantity of rainfall was to be taken into the sewers, rubbish and silt being separated out by means of catch-pits. The discharge of sullage and flush-water was assumed to be equivalent to 1 inch of rainfall per hour, and all surface drains were calculated to carry this discharge when running 2-3rds full.

Any discharge in excess of this was considered as storm-water and the intercepting drains were designed to carry a storm-discharge of 3" per hour. At the termination of the intercepting drains catch-pits were placed to hold up all rubbish and silt, and to pass on the sullage to the sewage mains. The storm discharge was intended to pass clear over the catch-pits into the nullahs.

The designs of the catch-pits had to be suited to the exigencies of each site, and owing to the interruption in the flow caused by the gratings, etc., which separated out the silt and rubbish, no exact theoretical calculations were possible by which the catch-pits could be designed so as exactly to divide off the sullage flow from the storm-flow. Further experience with the catch-pits has led in most cases to radical alterations in their design. From these causes it is impossible to say really what maximum sullage discharge is in practice admitted to the sewers, but from observations made during rain it seems highly improbable that sullage at the rate of 1" per hour is admitted. Probably 1-10th of an inch per hour is nearer the actual. The execution of the Simla bazaar sullage project was thus intended to bring into the sewers a far larger discharge than was ever contemplated by the designers of the Simla Sewage Scheme. In practice it has brought a great deal less than was intended. Unfortunately no record can be traced in this office to show whether the decision to admit sullage to the sewers at the rate of 1" per hour was based on calculations of the carrying capacity of the sewers. It is thus impossible to say from previously recorded figures what the various mains are capable of carrying. However I have made fresh calculations using Kutter's formula and assuming that the sewers will not run more than 2-3rds full. The accompanying statement gives a list of the sewers, drains, etc., minimum gradients and discharges in cusecs when running 2-3rds full, also the areas (as given in the Simla bazaar sullage project) from which sullage is taken into the sewers and the discharges from these areas calculated at 1" per hour. It will be seen from this statement that sewers noted in the margin * are inadequate to take sullage discharge at the rate of 1" per

* Bara Simla, Boileauganj 5", Kasumpti, Northern Lakkar Bazaar, Jail.

hour. The point should, however, be referred to the Public Works Department, Punjab, as the Engineer-in-Charge, Water and Drainage Works, did not design this scheme.

Considering next the capability of the sewers for taking sewage supposing that the introduction of a flush system was complete. The total amount of sewage likely to be received daily may be taken as equal to the total future daily water-supply, i.e., 800,000 gallons. In Simla it is likely that the sewage flow would fluctuate to an unusual degree and it may be assumed that the whole daily volume of sewage would be discharged in a period of 6 hours.

Thus the rate of discharge may be taken at $\frac{800,000}{6 \times 60} = 2,222$ gallons a minute which may be divided among the 5 disposal works in the proportion to the respective populations served—

—	Population.	Assumed sewage discharge.	Assumed sewage discharge.	Capacity of sewage main, at the flattest gradient on the line, running 2-3rds full.	REMARKS.
		Gallons per min.	Cusecs	Cusecs.	
Lalpani	24,000	1,385	3.6	5.6	
Kasumpti	5,000	289	0.75	0.59	Too small for sewage.
North	7,000	404	1.05	0.74	Too small for sewage.
Summer Hill ...	750	43	0.11	0.28	
Snowdon	1,750	101	0.26	0.39	
Total	38,500	2,222			

From this rough computation it is seen that for sewage alone (*i.e.*, no allowance for sullage) the Kasumpti and North Sewers will be too small, while the remainder will suffice. If sullage is included the Lalpani main is also too small. These assumptions, however, should certainly be referred to the Public Works Department as they are by no means of universal application and may be refuted. It will be realised from the foregoing that the question whether the mains are large enough to carry off the sewage in the event of an universal flush system being installed depends greatly on the rate at which sullage is admitted to the sewers.

The allowance of 1" per hour is exceedingly large. In Glasgow the allowance for rainfall in addition to sewage is $\frac{1}{4}$ " per day, or $\frac{1}{96}$ th part of the Simla allowance. As a basis for discussion it is suggested that $\frac{1}{10}$ th of an inch per hour would be a proper allowance for sullage including rainfall. Whatever allowance is decided on it will be necessary to design the separating weirs so as to discharge down the ravines directly the determined quantity is exceeded.

The terminal works were specially designed by the Public Works Department to deal with the sewage of a population of 38,750 with the water-supply as then provided. It is estimated that at the pail depôts the contents of the pails are diluted in the proportion of 1·2 gallons of water per head of population. At the disposal works a further dilution takes place and is so arranged that the diluted sewage shall take 24 hours to pass through the tank. The capacity of the tank is a variable quantity depending on the amount of sludge lying at the bottom. It is suggested that the question whether the terminal works would be capable of dealing with the sewage when the water-supply is increased up to 800,000 gallons a day is one on which the designers of the scheme (*viz.*, the Punjab Public Works Department) should be consulted. Experience has shown that the terminal works are satisfactory under present conditions.

The criterion adopted in recommending certain latrines for conversion to the flush system is that of distance from the existing sewer. The list of 33 latrines contains only those within 300 feet of a sewer.

A statement is attached giving the distance of the remaining 30 latrines from the sewers and the cost of connecting them. The estimated amount is Rs. 1,64,000. It will be seen that the cost of connection is in some cases exceedingly high.

A. R. ASTBURY,

*Engineer-in-Charge, Water and Drainage Works,
Municipal Office, Simla.*

Public latrines.

Serial Nos.	Situation of the latrines.	Level of latrines by aneroid.	Level of main at proposed junction.	Difference in level.	Length of connection.	Minimum gradient of connection.	REMARKS.
					ft.		
1	Near Court Hill ...	6,860	6,750	110	460	1 in 4.18	
2	„ Rothney Castle ...	7,570	7,350	220	250	„ 1.13	
3	„ Jakko Village ...	7,550	7,300	250	1,800	„ 7.20	
4	Below Mayo Orphanage ...	7,260	6,269	991	3,000	„ 3.02	
5	„ Ruldoo Bhatta ...	6,690	6,342	348	710	„ 2.04	
6	On Jakko ...	8,000	7,600	400	1,000	„ 2.50	
7	Town View ...	6,690	5,882	808	4,500	„ 5.57	
8	Below Charleville ...	6,900	6,550	350	1,000	„ 2.86	
9	„ Carlton Hotel ...	6,920	6,852	78	1,000	„ 12.82	
10	At Bohimia ...	7,200	6,000	1,200	7,000	„ 5.83	
11	Below Katchery ...	7,050	6,950	100	500	„ 5.00	
12	„ Sarai ...	6,785	5,882	903	4,500	„ 4.98	
13	„ Slaughter House sweepers' quarters.	6,600	6,580	20	400	„ 20.00	
14	Dalni Garden ...	6,075	6,000	75	700	„ 9.33	
15	Dhobighat, Sarhan ...	6,052	5,882	170	700	„ 4.17	
16	Plague camps ...	6,350	6,325	25	40	„ 1.60	
17	Kaithu Jail ...	6,600	5,375	1,225	5,500	„ 4.49	
18	Gymkhana, Annandale ...	6,125	5,625	500	2,000	„ 4.00	
19	Annandale Garden ...	6,175	6,050	125	500	„ 4.00	
20	Dhobighat, Annandale ...	6,055	6,025	30	100	„ 3.33	
21	Below Grace Ville ...	6,150	5,625	525	1,000	„ 1.81	
22	Buchail Village ...	6,420	5,850	570	1,500	„ 2.63	
23	Dhar Village ...	6,275	6,000	275	1,150	„ 4.18	
24	Toll bar on cart road ...	6,500	6,192	308	2,300	„ 7.47	
25	Below Kensington Hall ...	6,450	6,300	150	1,500	„ 10.00	
26	Tawi ...	6,650	5,571	1,079	3,500	„ 3.24	
27	Between Tawi and Boileauganj Octroi Post.	6,725	6,474	251	900	„ 3.58	
28	Boileauganj Octroi Post ...	6,775	5,571	1,104	4,500	„ 3.74	
29	Kali temple, Summer Hill ...	6,750	5,484	1,316	4,500	„ 3.42	
30	Below Summer Hill Pail Depot	6,500	6,430	70	410	„ 5.86	

Abstract of the approximate estimate of converting all (unimportant) latrines into flush system.

Serial No.	Sub-heads.	Quantity.	No. of Seats.		Total.	To be connected with the
			At present.	Proposed		
					Rs.	
1	Latrine near Court Hill ...	...	4	2	1,420	North Disposal Works Sewer.
2	" at Rothney Castle ...	...	10	2	1,000	Snowdon Sewer.
3	" at Jakko Village ...	...	2	2	4,100	Forest Lodge Sewer.
4	" below Mayo Orphanage ...	...	2	1	6,750	Snowdon Septic Tank.
5	" " Ruldoo Bhatta ...	...	6	4	2,420	North Disposal Works.
6	" " Jakko temple ...	...	2	2	2,500	Abergeldie Line
7	" near Town View ...	...	4	2	11,500	Lalpani Main.
8	" below Charleville ...	...	10	4	3,000	Central Hotel.
9	" " Carlton Hotel ...	...	16	8	4,000	Combermere Main.
10	" near Bohimia ...	...	1	1	20,250	Proposed a new separate septic tank.
11	" below Katchery ...	...	10	6	2,500	Katchery Main.
12	" " Sarai ...	...	10	4	11,500	Lalpani "
13	" " Slaughter House sweepers' quarters.	...	10	4	1,800	" "
14	" at Dalni Garden ...	...	6	2	1,900	" "
15	" at Dhobighat, Sarhan...	...	2	2	1,900	" "
16	" at Plague Segregation Camp.	...	3	2	580	" "
17	" at Kaithu Jail ...	...	16	10	14,000	North Disposal Works.
18	" at Gymkhana Club ...	...	2	2	4,500	" "
19	" at Annandale Garden ...	...	6	4	2,000	" "
20	" at Dhobighat, Annandale.	...	3	2	700	" "
21	" below Grace Ville ...	...	3	2	2,500	" "
22	" at Buchail Village ...	...	4	2	3,500	" "
23	" at Dhar Village ...	...	3	4	3,300	Dhar Village Sewer.
	Carried over ...	...	...	...	1,07,620	

Serial No.	Sub-heads.	Quantity.	No. of Seats.		Total.	To be connected with the
			At present.	Proposed.		
	Brought forward ...	...	...	...	Rs. 1,07,620	
24	Latrine at Toll bar on cart road	...	5	2	5,600	With the new proposed septic tank line beyond Boileauganj.
25	„ below Kensington Hall	...	4	2	3,500	Ditto
26	„ at Tawi ...	...	2	2	7,750	Summer Hill Septic Tank.
27	„ between Tawi and Boileauganj Octroi Post.	...	2	2	2,300	„ „ „
28	„ at Boileauganj Octroi Post.	...	3	2	10,000	„ „ „
29	„ below Kali Temple, Summer Hill.	...	2	2	15,000	Proposed a new septic tank.
30	„ Summer Hill Pail Depôt.	...	3	2	1,320	Summer Hill Main.
	GRAND TOTAL ...	...	...	...	...	1,53,090
	Add contingencies and petty establishment at 7 per cent.	...	...	...	...	10,716
						1,63,806
	or round ...	...	...	...	...	Rs. 1,64,000

Dated 22nd July 1914.

Abstract of the approximate estimate of converting all (unimportant) latrines into flush system.

Serial No.	Sub-heads	Quantity.	RATES.		Total.	Grand Total.
			At	Per		
			Rs.		Rs.	Rs.
<i>(1) Latrine near Court Hill.</i>						
1	4" Cast iron piping complete including trenches, lead joints, etc.	460 ft.	2	ft.	920	1,420
2	Flush latrines complete 2 seats water connection.	...	250	each	500	
<i>(2) Near Rothney Castle.</i>						
1	4" O. I. piping	250 ft.	2	ft.	500	1,000
2	Flush latrines	2 seats	250	each	500	
<i>(3) At Jakko Village.</i>						
1	4" C. I. piping	1,800 ft.	2	ft.	3,600	4,100
2	Flush latrines	2 seats	250	each	500	
<i>(4) Below mule road E. Mayo Orphanage.</i>						
1	4" Cast iron piping	3,000 ft.	2	ft.	6,000	6,750
2	Flush latrines	1 seat	250	each	250	
3	Bridges		Job		500	
	Carried over ... ..	...	...	...	...	13,270

Serial Nos.	Sub-heads.		Quantity.	RATE.		Total.	Grand Total.
				@	Per		
				Rs.		Rs.	Rs.
	Brought forward	...	...	...	...	...	13,270
	(5) <i>Latrine at Ruldoo Bhatta.</i>						
1	4" C I. piping	...	710 ft.	2	ft.	1,420	
2	Flush latrines	...	4 seats	250	each	1,000	
							2,420
	(6) <i>Near Jakko temple.</i>						
1	4" C. I. piping	...	1,000 ft	2	ft.	2,000	
2	Flush latrines	...	2 seats	250	each	500	
							2,500
	(7) <i>Latrine near Town View.</i>						
1	4" C. I. piping	...	4,500 ft.	2	ft.	9,000	
2	Flush latrines	...	2 seats	250	each	500	
3	Bridges	...			Job	2,000	
							11,500
	Carried over	...	...	...	...	...	29,690

Serial Nos.	Sub-heads.	Quantity.	RATE.		Total	Grand Total.
			@	Per		
	Brought forward ...	...	Rs. ...	...	Rs. ...	Rs. 29,690
	(8) <i>Latrine below Charleville.</i>					
1	4" C. I. piping ...	1,000 ft.	2	ft.	2,000	
2	Flush latrines ...	4 seats	250	each	1,000	
						3,000
	(9) <i>Below Carlton Hotel—</i>					
1	4" C. I. piping ...	1,000 ft.	2	ft.	2,000	
2	Flush latrines ...	8 seats	250	each	2,000	
						4,000
	(10) <i>Near Bohimin.</i>					
1	4" C. I. piping ...	7,000 ft.	2	ft.	14,000	
2	Flush latrine ...	1 seat	250	each	250	
3	Septic tank, Dilution tank, sweepers' quarters.			Job	5,000	
4	Bridge ...			Job	1,000	
						20,250
	Carried over ...	...	...	...	...	58,940

Serial Nos.	Sub-heads.		Quantity.	RATE.		Total.	Grand Total.
				@	Per		
	Brought forward ...		...	Rs.	...	Rs	Rs.
				...	...	...	56,940
	(11) Latrine below Katchery.						
1	4" C. I. piping	...	500 ft.	2	ft.	1,000	
2	Flush latrines	...	6 seats	250	each	1,500	
							2,500
	(12) Latrine below Sarai.						
1	4" C. I. piping	...	4,500 ft.	2	ft.	9,000	
2	Flush latrines	...	4 seats	250	each	1,000	
3	Bridges	...			Job	1,500	
							11,500
	(13) Below Sweepers' quarters Slaughter House.						
1	4" C. I. piping	...	400 ft.	2	ft.	800	
2	Flush latrines	...	4 seats	250	each	1,000	
							1,800
	Carried over ...		...	...	...	...	72,740

Serial Nos.	Sub-heads.		Quantity.	RATE.		Total.	Grand Total.
				@	Per		
				Rs.		Rs.	Rs.
	Brought forward	...	...	...	...	...	72,740
	<i>(14) Latrine at Dalni Garden.</i>						
1	4" C. I. piping	...	700 ft.	2	ft.	1,400	
2	Flush latrines	...	2 seats	250	each	500	
							1,900
	<i>(15) Latrine at Dhobighat, Sarhar</i>						
1	4" C. I. piping	...	700 ft.	2	ft.	1,400	
2	Flush latrines	...	2 seats	250	each	500	
							1,900
	<i>(16) Plague segregation Camp.</i>						
1	4" C. I. piping	...	40 ft.	2	ft.	80	
2	Flush latrines	...	2 seats	250	each	500	
							580
	Carried over	...	...	...	...	...	77,120

Serial Nos.	Sub-heads.		Quantity.	Rate.		Total.	Grand Total.
				@	Per		
	Brought forward ...		...	Rs.		Rs.	Rs.
				...	...	...	77,120
	<i>(17) Latrine below Kaithu Jail.</i>						
1	4" C. I. piping	...	5,500 ft.	2	ft.	11,000	
2	Flush latrines	...	8 seats	250	each	2,000	
3	Bridge	...			Job	1,000	
							14,000
	<i>(18) Gymkhana Club, Annandale.</i>						
1	4" C. I. piping	...	2,000 ft.	2	ft.	4,000	
2	Flush latrines	...	2 seats	250	each	500	
							4,500
	<i>(19) Annandale Garden.</i>						
1	4" C. I. piping	...	500 ft.	2	ft.	1,000	
2	Flush latrines	...	4 seats	250	each	1,000	
							2,000
	Carried over ...		...	...	...	...	97,620

Serial Nos.	Sub-heads.			Quantity.	RATE.		Total.	Grand Total.
					@	Per		
					Rs.		Rs.	Rs.
	Brought forward ...			...	...	...	...	97,620
	(20) <i>Dhobighat, Annandale.</i>							
1	4" C. I. piping	...	...	100 ft.	2	ft.	200	
2	Flush latrines	...	...	2 seats	250	each	500	
								700
	(21) <i>Below Grace Ville.</i>							
1	4" C. I. piping	...	...	1,000 ft.	2	ft.	2,000	
2	Flush latrines	...	...	2 seats	250	each	500	
								2,500
	(22) <i>Buchail Village.</i>							
1	4" C. I. piping	...	...	1,500 ft.	2	ft.	3,000	
2	Flush latrines	...	...	2 seats	250	each	500	
								3,500
	(23) <i>Dhar Village.</i>							
1	4" C. I. piping	...	...	1,150 ft.	2	ft.	2,300	
2	Flush latrines	...	...	4 seats	250	each	1,000	
								3,300
	Carried over ...			...	...	...	...	1,07,620

Serial Nos.	Sub heads.		Quantity.	RATE.		Total.	Grand Total.
				@	Per		
				Rs.		Rs.	Rs.
	Brought forward	...	...	...	...	...	1,07,620
	(24) Toll bar on Cart-road.						
1	4" C. I. piping	...	2,300 ft.	2	ft.	4,600	
2	Flush latrines	...	2 seats	250	each	500	
3	Bridges	...			Job	500	
							5,600
	(25) Below Kensington Hall.						
1	4" C. I. piping	...	1,500 ft.	2	ft.	3,000	
2	Flush latrines	...	2 seats	250	each	500	
							3,500
	(26) Tawi.						
1	4" C. I. piping	...	3,500 ft.	2	ft.	7,000	
2	Flush latrines	...	1 seat	250	each	250	
3	Bridges	...			Job	500	
							7,750
	Carried over	...	...	...	...	...	1,24,470

Serial Nos.	Sub-heads.		Quantity.	RATE.		Total.	Grand Total.
				@	Per		
	Brought forward	...	...	Rs. ...	...	Rs. ...	Rs. 1,24,470
	<i>(27) Between Tawi and Boileauganj Octroi Post.</i>						
1	4" C. I. piping	...	900 ft.	2	ft.	1,800	
2	Flush latrines	...	2 seats	250	each	500	
	<i>(28) Boileauganj Octroi Post.</i>						2,300
1	4" C. I. piping	...	4,500 ft.	2	ft.	9,000	
2	Flush latrines	...	2 seats	250	each	500	
3	Bridges	...		1 Job		500	
	<i>(29) Below Kali temple, Summer Hill.</i>						10,000
1	4" C. I. piping	...	4,500 ft.	2	ft.	9,000	
2	Flush latrines	...	2 seats	250	each	500	
3	Septic tanks, Dam wall, sweepers' quarters, etc.				Job	5,000	
4	Bridges	...			Job	500	15,000
	Carried over	...	...	...	...	...	1,51,770

Serial Nos.	Sub-heads.		Quantity.	RATE.		Total.	Grand Total.
				@	Per		
				Rs.		Rs.	Rs.
	Brought forward	...	...	...	...	...	1,51,770
	(30) Latrine below Summer Hill pail depôt.						
1	4" C. I. piping	... ..	410 ft.	2	ft.	820	
2	Flush latrines	... ..	2 seats	250	each	500	
							1,320
	Grand Total	...	...	...	...	...	1,53,090

Dated 22nd July 1914.
410DE

A. R. ASTBURY,
Engineer-in-charge,
Water and Drainage Works.
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APPENDIX 15.

Notes on the 30 public latrines not originally included in the E. W. D.'s list to be converted to flush system.

1. Near Court Hill :—

Is really a private latrine belonging to Court Hill Estate which is Municipal property. Should be done.

2. Near Rothney Castle :—

Is used by very few people. Is really not necessary as a public latrine at all, especially if the private latrines in the neighbourhood are made flush.

3. At Jakko village :—

For the villagers : about 60 to 100 people. So long as the village remains, a latrine is necessary. Should be done.

4. Below Mayo Orphanage :—

Is below Mule Road. Used by very few people. Is hardly necessary at all. If the Mayo Orphanage latrines are converted, however, the pipe would pass close to the latrine and it could then be done. Not thought necessary just now.

5. Below Ruldco Bhatta :—

Is very necessary. Should be done.

6. Near Jakko Temple :—

Only for the Faquir. Not probably necessary.

7. Near Town View :—

Used only by passers-by. Not thought necessary.

8. Below Charleville :—

Charleville has no private latrine and the servants use this. The owner should be made to instal a 2-seated flush latrine here, the Municipality only to pay for the pipe length of 900 feet. Really a private latrine therefore.

9. Below Carlton Hotel :—

A latrine is very necessary here. Should be done.

10. Near Bohimia :—

Is a single latrine below the Chota Simla Convent Road. Absolutely unnecessary.

11. Below Katchery :—

Should be done. In a crowded neighbourhood.

12. Below Sarai :—

By shifting the latrine up the khud about 30 feet it could be brought above the pipe line and the latrine would then cost only the amount of the seats. A 2-seated one would be sufficient.

13. Below Slaughter House :—

This is in the area on which we propose to build houses for the butchers (see note on Ladaki Mohalla). A latrine will be necessary, and the estimate may stand.

14. At Dalni Garden :—

On road to Lalpani. Not now necessary.

15. At Sarhan Dhobighat :—

Should be done. One of the new Dhobighats will be here.

16. At Plague Segregation Camp :—

This area will either be built on or kept as a Segregation Camp. Should be done.

17. At Kaithu Jail (*i.e.*, below the Jail and Barracks). A latrine is necessary here but probably one could be built at a higher level and at less cost.
18. At Gymkhana Club :—
Should be done.
19. At Annandale Garden :—
Should be done too.
20. At Dhobighat, Annandale :—
Should be done.
21. At Grace Ville :—
Is at Annandale, and supplies a considerable neighbourhood. Should be done.
22. At Buchail Village :—
Is a growing neighbourhood. Should be done.
23. At Dhar Village.
A sewage extension will certainly be necessary here. Should be done. Other latrines will be needed later.
24. Latrine at Toll Bar on Cart Road :—
Not necessary to be converted now—only a single house.
25. Below Kensington Hall :—
Is used very little—a latrine is hardly necessary at all here.
26. At Tawi.
27. Between Tawi and Octroi Post. }
- These 2 are on the road to Jutogh and very seldom used. Are hardly necessary.
28. At Boileanganj Octroi Post :—
If this were put on the other side of the road—about 30 yards only—it could be connected with the Lalpani main at very much less cost.
29. Below Kali Temple, Summer Hill :—
Could be converted later when Summer Hill developes. Not necessary now.
30. At Summer Hill :—
This should be done but could be brought up to the Pail Dépôt and the cost much reduced.

The following are now recommended to be converted to flush system :—

							Cost. Rs.
1. Court Hill	...	...	...	...	...	...	1,420
2. Jakko village	...	..	...	...	...	...	4,100
3. Ruldoo Bhatta	...	...	...	...	...	...	2,420
4. Charleville—							
Cost of 900 feet piping only.	Latrine to be made by owner	...	...	...	...	...	1,800
Below Carlton Hotel	...	...	...	...	...	...	4,000
6. Below Katchery	...	...	...	...	...	...	2,500
7. Below Serai—							
To be shifted higher, say	...	...	...	...	...	...	2,000
8. Below slaughter house	...	...	...	...	...	...	1,800
9. Sarhan	...	...	...	...	...	...	1,900
Carried over							21,940

							Cost. Rs.
				Brought forward	...		21,940
10.	Below Kaithu jail.	Cost could be reduced by shifting higher	...	...	...		14,000
11.	Annandale Gymkhana club	...	...	...	...		4,500
12.	„ gardens	...	...	...	...		2,000
13.	„ Dhobighat	...	...	...	...		700
14.	„ below Grace Ville	...	...	...	...		2,500
15.	Buchail	...	...	...	...		3,500
16.	Dhar	...	...	...	...		3,300
17.	Boileauganj to be shifted to other side of road, say	...	...	...	...		3,000
18.	Summer Hill ; to be placed near Pail Depôt, say	...	...	...	...		1,000
				Total	...		<u>56,410</u>

When these have been completed, it may be found that other convenient places suggest themselves for public latrines. A sum of Rs. 13,660 has therefore been added to the above sum of Rs. 56,440, making a total of Rs. 70,000 under this head.

A. D. STEWART.

APPENDIX 16.

Estimate for Installing a Flush Sewage system for Mashobra Bazaar.

The sanitary scheme consists of

Mashobra, East...	...	...	...	1 Pail Depôt.
				1 Five-seated flush latrine.
Mashobra, West	...	...	...	1 Pail Depôt.
				1 Five-seated flush latrine.

Total ... 2 Pail depôts @ 450 each = Rs. 900

Total ... 10 seats @ 230 „ „ 2,300

Rs.

4" Sewage mains to connect Mashobra, East and West distance $\frac{1}{2}$ mile to a common 4" main leading to a septic tank. The branch main would be laid at a gradient of 1 in 20, and it would be necessary to acquire a strip of land about 5 feet wide along the pipe track. $3,000' \times 5' = 15,000$ feet $2 = 0.344$ acres @ say Rs. 500 per acre ... 172

The outfall would be laid straight from the junction of the two branches to the site selected for the septic tank. Total length of sewage piping say 3,000 feet @ Rs. 1-14 ... 5,625

The water for flush purposes and for dilution at the septic tank will have to be drawn entirely from the pipe supply as there is not sufficient obtainable elsewhere at the required level. Water-supply service to 2 pail depôts, 2 flush latrines, and 1 septic tank say ... 300

The main as at present laid down from Charabra to Mashobra is calculated to supply daily 20,000 gallons. The demand, including the sanitary arrangements under consideration, would be about 6,150 gallons a day. The present main will therefore suffice. The septic tank would be on the same lines as that at Lalpani, with possibly the improvement of a cover. The capacity would be $200 \times 10 = 2,000$ gallons, and the cost about ... 500

The total cost of the scheme would be

					Rs.
Pail depôts and latrines	...	...	...	...	3,200
Land	...	...	...	...	172
Pipes	...	...	...	...	5,625
Water-supply	...	...	...	...	300
Septic tank	...	...	...	...	500

Total 9,797 say Rs. 10,000

which is equivalent to Rs. 50 per head of the assumed population of 200.

J. H. O'BRIEN,
for *Engineer-in-Charge*,
Water and Drainage Works.

APPENDIX 17.

**Estimates for paving ravines and improving surface drains
including Combermere Nullah.**

Rs. 1,60,075.

410DE

*Abstract of estimates for paving the nullahs and improving surface drainage
in Ward no. 1.*

No.	Particulars.	Amount.
		Rs.
1	Nullah from the public road below Jail Depôt no. 14 to the road leading to St. Bernard	872
2	Nullah from Kaithu Jail (below catchpit) to Municipal latrine no. 16 ...	1,092
3	Nullah from Constance Lodge to the Khud below Stanley Lodge ...	1,869
4	Nullah from Holcombe to Pail Depôt no. 18 below Melbourne ...	2,578
5	Nullah from Brahmsmaj Mandir to Stretmeore	2,353
6	Nullah between the servants' quarters of Oak Lodge and Race View ...	1,003
7	Nullah running at the back of the stables of Cecil Hotel	643
8	Nullah from the servants' latrine Avondale to Cart Road	459
9	Nullah from house no. 13-1 Boileaugunj to Cart Road	1,906
10	Nullah from the back of Post Office down to the Lovers' walk at the junction of road leading to coolies' line at Court Hill	417
11	Nullah from servants' quarters near St. Mark connected with the drains above the road leading to the Jail	646
<i>6" glazed stoneware drains.</i>		
12	On public road below Ellerslie Cottage	529
13	On public road below Benville near Summer Hill Post Office ...	529
14	On public road below Tara Hall (Loreto Convent)	718
15	On public road below Government cottages (on road to Annandale) ...	458
16	On road above Pentland and Castle Grove	383
17	Opposite Minto Court	89
18	On Mall below Gorton Castle—East and West storm water ...	307
19	On road to Dhar and below Hirjee Lodge	191
20	On road to Dhar and below Sophia Ville	86
21	On public road from Ensham to Firwood	1,587
22	Roadside drain on the road to Dhuni Dhar	48
23	Roadside drain on the road from Mall to Gorton Castle	118
	Carried over ...	18,881

Abstract of estimates for paving the nullahs and improving surface drainage in Ward no. 1—contd.

No.	Particulars.	Amount.
		Rs.
	Brought forward ...	18,881
24	Roadside drain on the long road to Annandale from Kennedy House ...	546
25	Roadside drain on the Mall below Gorton Castle ...	552
26	Roadside drain in front of the boys' School at Boileaugunj ...	204
27	Roadside drain from His Excellency the Viceroy's Lodge to the entrance of Boileaugunj Bazaar ...	408
28	Roadside drain on the road to Annandale road... ..	609
29	From Knockdrin to Annan View on the Mall ...	1,395
30	From Hotel Cecil to the entrance of Farnham Lodge ...	384
31	On the north of Mall from opposite Chaura Maidan Post Office to the Municipal Rickshaw shed ...	814
32	From Municipal hydrant below Armsdell by the Burj to Viceregal Lodge ...	1,365
33	From road to Courteen Hall to the nullah near "Wo dfield" ...	268
34	From Boileaugunj Bazaar to nullah below Courteen Hall ...	315
35	From Municipal hydrant Boileaugunj and by the Municipal Committee Serai ...	733
36	From Kenfield to the road near Chaura Maidan Post Office ...	203
37	From Chaura Maidan Post Office to the road leading to Ava Lodge in front of Holcomb and from the north gate of Ava Lodge to the gate leading to Norwood ...	2,158
38	On Cart road from below Carton cottage to the nullah west of Cecil Hotel stables ...	980
39	On road to the east of Viceregal Estate from the gate leading to Morvyn to the drain leading under the road ...	1,141
40	On road below Holme at Summer Hill ...	124
41	On road from Municipal hydrant below Ivanhoe Cottage to Constance Ville ...	1,006
42	On road to Annandale from Constance Lodge to the road leading to Dhoni Dhar ...	168
43	A 6" glazed stoneware drain along the road from Bank of Bengal to Fingask ...	560
44	A 6" glazed stoneware drain along the road side from servants' quarters (Telegraph) above Court Hill to the nullah west of entrance to Court Hill ...	281
	Carried over ...	33,095

Abstract of estimates for paving the nullahs and improving surface drainage in Ward no. 1—concl'd.

No.	Particulars.	Amount.
		Rs.
	Brought forward ...	33,095
	<i>9" cast iron drains.</i>	
45	9" cast iron drain on the nullah east of Viceregal stables and under the new road to Annandale ...	1,371
46	9" cast iron drain near catchpit near Boileaugunj stables ...	473
47	9" cast iron drain from catchpit near entrance to Dormers to drain below ...	307
	<i>Stone paved drains.</i>	
48	Constructing a stone paved drain on the Mall from Pail Depôt no. 3 to take sullage from houses above Mall ...	111
49	Constructing a stone paved drain on the nullah west of Norwood from the road by servants' latrine ...	86
50	Constructing a stone paved drain on the nullah from Viceregal Lodge Estate under the road to Summer Hill near Electrical Power House ...	136
51	Constructing a stone paved drain on the nullah under the road to Annandale by Sunnyside to the ravine below ...	429
52	Constructing a stone paved drain on the nullah from Kaithu Jail to Khud below ...	298
53	Constructing a stone paved drain between North Bank and Dormers near the entrance to Snow View ...	121
54	Constructing a stone paved drain in continuation of M. C. drain west of Sunny Bank to Cart Road ...	97
	Total ...	36,524
	<i>General Abstract.</i>	
		Rs.
	(1) Paving nullahs ...	13,838
	(2) Constructing 6" glazed stoneware drains ...	19,257
	(3) Constructing 9" cast iron drains ...	2,151
	(4) Constructing stone paved drains ...	1,278
	Total ...	36,524

*Abstract of estimates for paving the nullahs and improving surface drainage
in Ward no. 2.*

No.	Particulars.	Amount.
		Rs.
1	Improving drain in the nullah below catchpit no. 5 on the Cart Road below Veterinary Hospital by putting 9" cast iron open drain ...	2,051
2	Improving drain below catchpit no. 6 near Municipal Serai by putting 9" cast iron drain	1,317
3	Improving drain in the nullah below catchpit no. 7 on the Slaughter House road by putting 9" cast iron drain	1,818
4	Improving drain below catchpit no. 9 on the Slaughter House road by putting 9" cast iron drain	373
5	Improving drain in the nullah below catchpit no. 11 near Abdullah contractor's house at Ladaki Mohalla by putting 9" cast iron drain	1,622
6	Improving the drain in the nullah below catchpit no. 13 up to Skin house by putting 9" cast iron drain	3,177
7	Improving drain in the nullah below catchpit no. 17 near Government High School up to sewage line road bridge by putting cast iron open drain	2,304
8	9" S. W. closed pipe under the Mall opposite Old Fire Station running towards Alley no. 6	110
9	6" S.W. open drain in the nullah under the road to Bantony (West of Telegraph Office)	65
10	Putting 6" S. W. open drain on the road from Lower Bazaar to beyond Ripon Hospital Entrance gate (Chor Bazaar) <i>via</i> Dilkusha ...	513
11	Putting 6" S. W. open drain on the road side from the Ridge near the Church to Mall near Liddel's	743
12	6" S. W. drain under the Mall near Cotton and Morris (from the hydrant to the Lower Bazaar road entrance)	193
13	6" S. W. open drain along the road in front of Dhaupat's stables above the Market	578
14	6" S. W. open drain at the back of Fish shops down to Sooji line ...	309
15	Putting 6" S. W. open drain near the Executive Engineer's Store Godown on the Cart Road near the hydrant	68
	Carried over ...	15,241

Abstract of estimates for paving the nullahs and improving surface drainage in Ward no. 2—concl'd.

No.	Particulars.	Amount.
		Rs.
	Brought forward ...	15,241
16	6" S. W. open drain from Bevan Petman's Flour Mill and by the entrance to Government High School Boarding House to the main drain (opposite side of the road)	315
17	9" cast iron drain below catchpit no. 15 to be connected with the cast iron drain below	779
18	Stone paved drain in the nullah below catchpit no. 18 near Government High School	875
19	Prolonging the present cast iron drain east of Ellingham and discharging it into the open space	1,332
20	6" S. W. open drain in place of stone flagged drain from Chor Bazaar to Belville south <i>via</i> Government Press	656
21	6" S. W. open drain on the Mall opposite Morton's to Framjee's ...	239
22	6" S. W. open drain on the approach roads to Lawrence Gunj W. E. corners	155
	Total ...	19,592

*Abstract of estimates for paving the nullahs and improving surface drainage
in Ward no. 4.*

No.	Particulars.	Amount.
		Rs.
1	Constructing 6" S. W. drain from Edgworth and under Mall between Fitzroy Villa and Kristan Hall	283
2	Constructing 6" S. W. drain on road from the gate of Chillingham below servants' quarters of Edelweiss (sullage and bath room water)	190
3	Constructing 6" S. W. drain below Rothney cottage (bath room water)	616
4	Constructing 6" S. W. drain on the public road below Chillingham and by Milsington (sullage water)... ..	667
5	Constructing 6" S. W. drain on public road below Hawksford, Dalshanghee and Central Hotel	1,409
6	Constructing 6" S. W. drain below Murrayfield opposite the gate leading to Convent (bath room water)... ..	465
7	Constructing 6" S. W. drain on Cart Road below Craigs Ville cottages (sullage and bath room water)... ..	522
8	Constructing 6" S. W. drain from Prospect Lodge towards Walsingham	333
9	Constructing 6" S. W. drain on road near Cloverly (bath and sullage water)	399
10	Constructing 6" S. W. drain from Lakkar Bazaar to Salvation Army and in front of it	732
11	Constructing 6" S. W. drain on Mall from the approach road to Cedars and by Cedars Lodge (storm water)	468
12	Constructing 6" S. W. drain on Mule road near the steps leading to the Pail Depôt no. 6 to the nullah west of Oaks	222
13	Constructing 6" S. W. drain on road below servants' quarters of Bayneston to the drain east of Mission School	208
14	Constructing 6" S. W. drain from Stoke Lodge to the entrance of Glen View	306
15	Constructing 6" S. W. drain along Cart Road below Carlton Hotel to Craigs court out-houses	908
16	Constructing 6" S. W. drain from the last shop of Chota Simla Bazaar to Boundary	1,218
17	Constructing 6" S. W. drain from entrance Mall Chota Simla Bazaar to roadside drain	102
18	Constructing 6" S. W. drain from Ness Villa by Allen Bank to Knollswood Lodge	1,006
19	Constructing 6" S. W. drain on the Mall from road to Bridge View near Combermere Bridge Post Office	284
	Carried over ...	10,389

*Abstract of estimates for paving the nullahs and improving surface drainage
in Ward no. 4—contd.*

No.	Particulars.	Amount.
	Brought forward ..	Rs. 10,339
	<i>Paving of ravines.</i>	
20	Paving nullah between Armadale and Armadale Cottage ...	1,195
21	Paving nullah between Alicemont and Franklin Villa ...	1,381
22	Paving nullah between Fitzroy Villa and Kristan Hall ...	1,423
23	Paving nullah between Torrentium Lodge and Octagon Lodge ...	2,300
24	Paving nullah near Blair Athol ...	1,145
25	Paving nullah between Walterton and Charleville ...	1,110
26	Paving nullah from the south of Glenmire, a portion below reservoir south of the kutchah house in Shankli ...	1,452
27	Paving nullah from the entrance to Rookville to the entrance of Rookville Cottage ...	137
28	Paving nullah south of Carlton Hotel below Cart Road ...	2,040
29	Paving nullah from catchpit below Central Hotel ...	615
30	Paving nullah west of Central Hotel near Bemloe Estate ...	1,287
31	Paving nullah from catchpit near Pail Depôt no. 13 to below the old Malt House ...	2,948
32	Paving drain from the Mall by Alexandra Hotel to the Municipal drain	161
33	Paving nullah south of Carlton Hotel to Cart Road ...	651
34	Paving nullah from Barnes Court below Pine House Estate ...	2,877
35	Paving nullah from Oakwood place and by Nash Ville to Franklin House	1,497
36	Paving drain along the Mall near road entrance to Fitzroy Villa ...	106
37	Paving nullah below Central Hotel stables ...	895
38	Paving roadside drain along the Mule Road in front of Willows ...	61
39	Paving along the Mall between nullahs east and west of Alexandra Hotel ...	231
40	Paving roadside drain from Oakover north gate to south gate ...	319
	<i>Cast iron drains.</i>	
41	Constructing 9" cast iron drain in nullah below Mule Road near Belvedere	4,034
42	Constructing 9" cast iron drain in the nullah west of the Oaks to Pail Depôt no. 5 ...	1,372
43	Constructing 9" cast iron drain in the nullah from Winscottie Cottage to below the Mule Road ...	3,926
44	Constructing 9" cast iron drain in nullah below the Willows Cottage to road to Bhatta Ruldu ...	2,133
	Carried over ...	45,685

*Abstract of estimates for paving the nullahs and improving surface drainage
in Ward no. 4—concl'd.*

No.	Particulars.	Amount.
		Rs.
	Brought forward ...	45,635
45	Constructing 9" cast iron drain in the nullah east of Baptist Mission School from Bayneston to below the Mule Road ...	3,207
46	Constructing 9" cast iron drain in nullah from the road near Rooksly to below the Mall near Alexandra Hotel ...	2,523
47	Constructing 9" cast iron drain in nullah between Hawksford Dalshanghee to road below ...	1,389
48	Constructing 9" cast iron drain in the nullah between Vincent House and Ness Ville ...	1,117
	Total ...	53,871
	<i>(Combermere Nullah.)</i>	
49	Constructing cast iron drain in Combermere Ravine from tap to road (Nullah no. 1) ...	15,424
50	Constructing cast iron drain in the Combermere Ravine below the Mall to below the Cart Road (Nullah no. 2) ...	9,722
51	Constructing cast iron drain in Nullah no. 3 from Oak Ville to Combermere Ravine passing by U. S. Club ...	9,140
52	Constructing 6" S. W. drain in Nullah no. 4 from Abergeldie Hotel to Combermere Ravine ...	1,347
53	Constructing 6" cast iron drain in Nullah no. 5 from Tennis Court of Abergeldie Hotel to Combermere Ravine ...	3,762
54	Constructing 9" cast iron drain in Nullah no. 6 from Jakko top below road to Everest to Combermere Ravine ...	10,693
	<i>Note.—In connection with this estimate please see accompanying plan.</i>	
	Total ...	50,088
	Grand Total Rs....	1,03,959
	<i>General Abstract.</i>	
		Rs.
(1)	6" S. W. drains ...	10,339
(2)	Paving ravines ...	23,831
(3)	C. I. drains ...	19,701
(4)	Combermere Section ...	50,088
	Total ...	1,03,959

APPENDIX 18.

List shewing the proposals made by the Simla Improvement Committee of 1907 for the acquisition of buildings in the Main Bazaar for sanitary reasons and shewing action taken.

Serial No.	DESCRIPTION OF HOUSE PROPERTY.			Owner's Name.	Area in square feet.	Rate per square foot of area.	Rate per square foot of materials.	Probable compensation payable.	Reasons for acquisition or removal.	Action taken.	
	Khasra No.	Municipal No.	Where situate.								
1	116 115	59 60	Pahari Chakla	Faiz Mohamad Lachman Thunian	396 597	2 2	Rs. A. P. 2 0 0 2 0 0	Rs. 1,584 2,388	1. These are insanitary houses and their acquisition is necessary to open up a congested area in which there is a largely used public latrine and which is badly in need of ventilation.	These houses have been rebuilt on more sanitary lines.	
2	56 57 58	Lower Bazaar	1,000	2. This is a long narrow alley completely roofed over by a verandah. Latrine opens into this alley which is not ventilated and is most insanitary. The verandah roof should be removed and the rooms belonging to the adjacent houses 56, 57 and 58 which are apparently encroachments on the alley should also be removed.	Nothing has been done here.	
3	13 12	Kashmiri Mohalla	Mohammad Umar, Hira Lal and Ram Kishen.	772	2	1 0 0	2,000	3. These are most insanitary single storeyed and mud roofed hovels opening on to a dark alley. The removal is urgently required for sanitary reasons.	Ditto ditto.	
4	339	83	Old Butcherkhana	Momed Sultan and Radha Mal	1,190	1	2 0 0	3,570	4. These 12 houses form a block of buildings occupied by butchers. The rooms are dark and insanitary, and the death rate in the houses is said to be specially high. The complete demolition of those buildings is very desirable for sanitary reasons.	Nos 83 and 96 have been acquired and demolished but the remaining buildings are in the same condition as before.	
	340	84		Kadar Baksh	598	1	3 0 0	2,392			
	341	85		Allah Baksh	560						
	342	86		Musammam Hemo, wife of Rahim Bax.	600						
	343	87		Nannu	640						
	348	88		Hafiz Illahi Bux	574						
	349	90		Illahi Bax and Kadru	507	...	3 0 0	18,000			
	350	92		Allah Bax	532						
	351	93		Ghulam Rasul	532						
	352	94		Barkhu	532						
5	356	95	Near the Butcherkhana...	Abdul Karim	546				5. This house is very insanitary. Its removal is urgently necessary.	It has been demolished and rebuilt.	
357	96	Ram Kishen Musammam Gangi		973 512	1	0 8 0	700				
6	...	95	Alley behind house No. 95 in the Lower Bazaar.	Banwari Lal	...	Area not necessary as eaves and verandahs only are to be removed.			500	6. This is a very dark alley overhung by two verandahs with wide eaves. It is proposed to have the verandahs and eaves removed and to provide gangways to allow the sweeper access to the latrines. The verandahs are not required for the access of tenants as there are stairs inside the house.	Nothing has been done yet.
7	...	5	Top storeys of 2 houses in old Butcherkhana.	Poopa and Chappal	...	Area not necessary as only the top storeys of the 2 houses are to be removed.			1,000	7. The removal of the top storeys of these two houses is required so as to open up a very narrow and insanitary alley.	Nothing has been done.
	...	6									
8	253	2	House No. 2, Alley No. 10, Kashmiri Mohalla.	Puran Mal	933	2	8 0 0	9,390	8. These houses are bounded on 3 sides by dark insanitary alleys. Their demolition is very desirable for the adequate lighting and ventilation of the surrounding buildings.	These houses are in the same condition	
	253	2-A	House No. 2 Kashmiri Mohalla.	Ditto	379	2	8 0 0	3,790			
	13	1	House No. 1 Kashmiri Mohalla.	Rustamju, etc.	770	...	...	4,000	
9	35	33	Middle Bazaar	K. S. Fakhruddin	987	3	7 0 0	9,870	9. These houses form a block bounded on one side by the Middle Bazaar road and on the other by a narrow alley. Their demolition is required both for sanitary reasons and also to widen the road for traffic.	None of these have been touched.	
	...	34		Muhammadju and Ahmadju...	231	3	4 0 0	1,617			
	...	35									
	34	36									
	223	18 38									
10	224 222 223	...	Kashmiri Mohalla	Abdul Khaliq	670	2	3 0 0	3,350	10. The acquisition of these houses is required so as to make a thoroughfare between the Mall and the Lower Bazaar. The thoroughfare will help to open up a congested area and will be useful as a fire line and for ventilation of the whole of this side of the Bazaar.	Nos. 2 and 3 have been entirely rebuilt. The others remain as before.	
	220	19 2		Abdul Islam	528	2	4 0 0	3,168			
	...	3		Shibba Divana	742	3	3 0 0	4,652			
	230	73		Lower Bazaar	Manju Mal	485	6	15 0 0			10,185
Total								21,355			
Grand Total								83,156			

APPENDIX 19.

Lists of buildings in Main and outlying Bazaars proposed for acquisition,
with details of cost.

MAIN BAZAAR.
Kashmiri Mohalla.

Number of House.	Owner.	Assessment.	Estimated cost of acquisition.	Remarks.
		Rs.	Rs.	
Shop 1	Abdul Khaliq	125	1,900	
Houses 11, 12, 13	Mohamed Umar, Hira Lal and Ram Kishen,	215	3,260	
14	Aisha Bibi	425	6,555	
15	Permanand Badri Dass ...	325	5,000	
16	Abdul Ahed and others ...	200	3,070	
17	Malika Begam	175	2,617	
18 & 38-1	Abdul Khaliq	275	4,225	
19	Abdul Islam	350	5,390	
33, 34 & 35 shops.	Fakhruddin	550	8,450	
36	Mohamadju Ahmadju ...	125	1,900	
44	Ghanta Mal	50	775	
45	Mathra Das	50	775	
46	Mohamadju ... ..	...	1,640	
	Total ... ..	...	45,587	

MAIN BAZAAR.

Pahari Chakla and Alley No. 2.

Number of House.	Owner.	Assessment.	Estimated cost of acquisition.	Remarks.
		Rs.	Rs.	
1, 2, 3	Mohamad Khizer and Shahab Din	325	4,945	
54	Mussanmat Fahiman ...	275	150	Part only.
61	Thunia Lachman ...	300	135	Part only.
53	Shibba Diwana ...	450	6,945	
9 Godowns.	Hussain Bux & Co. ...	...	1,380	
45 Godowns.	Maula Bux ...	100	1,530	
46 Godowns.	Patiala State ...	100	1,520	
	Total ...	...	16,605	

MAIN BAZAAR.
Improvement of Alleys.

Number of House.	Owner.	Assessment.	Estimated cost of acquisition.	Remarks.
		Rs.	Rs.	
56, 57, 58	.....	...	300	
		<i>Alley</i>	<i>No. 5.</i>	
63	.....	...	...
7	.....	...	...
8	.....	...	...
9	Permanand ...	950	14,660	
6	Chowdhery Ghungar ...	275	4,225	
30	Shibba Diwana ...	675	10,435	
32	Diwana Khazana ...	450	6,935	
62	Phul Chand ...	500	7,730	
		<i>Alley</i>	<i>No. 12.</i>	
74	Ram Gopal ...	...	250	Corner only to be acquired.
		<i>Alley</i>	<i>No. 13.</i>	
Sweepers' shed, and adjoining ground.	Mohamad Rafiq ...	...	500	
		<i>Alley</i>	<i>No. 14.</i>	
95	.....	...	...
95-5	.....	...	...
96	Hori Lal ...	800	12,420	
		<i>Middle</i>	<i>Bazaar.</i>	
18	Surjan Mal ...	100	1,508	
19	Hussain Bux & Co. ...	125	2,070	
	Carried over ...	...	61,033	

MAIN BAZAAR.
Old Butcherkhana.

Number of House.	Owner.		Assessment.	Estimated cost of acquisition.	Remarks.
	Brought forward	...	Rs. ...	Rs. 61,033	
128	Permanand Mouja Mal	...	775	11,970	
129	Agia Mal...	...	350	5,372	
130	Chaina Mal	...	2,025	31,325	
131		...			
132		...			
133	Gulam Mohammad	...	1,075	16,595	
134		...			
135	Noranga Mal	...	1,175	18,110	
136	Khazana Mal	...			
137	Duni Chand	...	1,350	20,830	
138	Badhawa ...	...		
139	Abdul Gafur	...	2,875	44,485	
140		...			
141-1	Mohammad Sultan	...	3,575	55,200	
142		...			
143		...			
144		...			
145	Nagar Jaishi	...	300	4,595	
5		...			
6	Gujjar Mal	...	375	5,710	
7		...			
8	Tirlochan Joti	...	175	2,655	
9	Kali Charan	...	450	6,900	
97	Jagannath, Sita Ram	...	850	13,090	
26	Abdula, son of Chota	...	375	5,675	
27	Azimullah	...	775	11,920	
82-3	Kadar Bux	...	450	6,900	
84	Alla Bux ...	...	225	3,415	
85	Carried over	...	...	3,25,780	

MAIN BAZAAR.

Old Butcherkhana—concl'd.

Number of House.	Owner.	Assessment.	Estimated cost of acquisition.	Remarks.
		Rs.	Rs.	
	Brought forward ...	...	3,25,780	
86	Hemo, wife of Rahim Bux ...	400	6,130	
87	Nanoo	175	2,640	
88 & 89	H. Elahi Bux ...	600	9,215	
90	Elahi Bux and Kadroo ...	225	3,425	
91	H. Elahi Bux ...	500	7,675	
92	Alla Bux ...	220	3,425	
93	Ghulam Rasul ...	225	3,425	
94	Barkhu ...	325	4,975	
95	Abdul Karim ...	325	4,975	
	Total ...	...	3,71,665	
	In round figures ...	...	4,00,000	

MAIN BAZAAR.
Ladaki Mohalla.

Number of House.	Owner.	Assessment.	Estimated cost of acquisition.	Remarks.
		Rs.	Rs.	
105	Bhag Mal	350	5,330	
106	Didar Bux	275	4,175	
1071	Mumtaz Hossain	550	8,487	
107	Kadar Bux	125	1,905	
108	Kali Charn	950	14,687	
109 & 109-1	Kabirjoo	1,400	21,475	
110	Rahim Bux	350	5,382	
111-16-4 <i>Cart Road.</i>	Mohammad Sultan	1,625	24,995	
111-2 blocks.	Jijoo	350	5,140	
112	Abdul Ali	1,900	29,410	
113	Elahi Bux	50	603	
113-1	Nuri Pagli	675	10,384	
114	Mohammad Sultan	900	13,800	
115 & 115-1	Abdulla	600	9,124	
116	Gainda and others	325	4,933	
117	Abdul Aziz	400	6,123	
118-1	Abdul Ghani	150	2,259	
119	Chedi	325	4,975	
120 & 121	Hussain Bux	325	4,958	
122	Alla Bux	100	1,508	
123	Ellahi Bux	550	8,469	
124	Kala	100	1,508	
125	Imam Bux	100	1,465	
126	Imam Din	200	2,949	
127	Chedi	550	8,322	
128	Jijoo	300	4,613	
129	Mohamed Shafi	100	1,500	
130	Pir Mohamed	200	1,518	
	Total ... ..	...	2,09,997	
	In round figures ... ..	...	2,10,000	

410DE

Number of House.	Owner.	Assessment.	Estimated cost of acquisition.	Remarks.
		Rs.	Rs.	
Shop. 13 & 14	225	3,408	
15 & 16	245	3,717	
17	125	1,854	
18	125	1,854	
House.				
4	75	1,077	
5 & 5-1	50	690	
5-2	50	690	
Total	13,290	

[illegible]

Lakkar Bazaar.

Number of House.	Owner.	Assessment.	Estimated cost of acquisition.	Remarks.
Shop 1	Rs. 225	Rs. 3,493	
2	275	4,269	
3	275	4,269	
3-1	275	4,269	
4	475	6,391	
5-6	225	3,493	
7	350	5,433	
8	300	4,658	
9	300	4,658	
10 & 11	1,250	19,406	
12 & 13	1,025	15,913	
14	675	10,478	
15	400	6,210	
15-1	350	5,433	
15-2	300	4,658	
16	325	4,976	
17 & 35-1	325	5,118	
18 & 35	450	6,943	
19 & 34	275	4,191	
20 & 33	275	4,191	
21 & 22	275	4,226	
	Carried over ...	...	1,32,676	

Lakkar Bazaar—concl'd.

Number of House.	Owner.	Assessment.	Estimated cost of acquisition.	Remarks.
		Rs.	Rs.	
	Brought forward ...	...	132,676	
Shop.				
21-1 & 32-1	.....	275	4,226	
22 & 31	.....	450	6,917	
23 & 30	.....	400	6,141	
24 & 29	.....	350	5,352	
25 to 28	.....	575	8,867	
36	.....	600	9,315	
37	.....	400	6,210	
38	... ..	275	4,269	
39	.....	500	7,762	
40	... ..	550	8,539	
41	... ..	400	6,210	
42	.....	225	3,493	
43	... ..	200	3,105	
Block behind Shops 10-13 (upper line.)	.....	...	3,536	
House 3 be- hind shops 5-9 (upper line).	.....	...	7,072	
	Total ...	...	2,23,720	
	In round figures Rs. ...	...	2,20,000	

APPENDIX 20.

Statement showing estimated cost of acquisition and reconstruction and Revenue expected from Reconstruction in the Bara Bazaar and Outlying Bazaars.

A—Outlying Bazaars.

Area.	Cost of acquisition.	Cost of Reconstruction.		Total cost of Recons- truction.	Revenue expected.	How calculated.
		Non-productive.	Productive.			
	Rs.	Rs.	Rs.	Rs.	Rs.	
Lakkar Bazaar	2,20,108	3,500	1,09,500	1,13,000	10,950	10 per cent on cost.
Kailhu Bazaar	13,290	...	11,510	11,510	1,150	10 "
Chota Simla	15,010	...	...	...	...
Boileanganj Bazaar	35,788	...	25,883	25,883	2,602	
Total	2,84,146	3,500	1,46,893	1,50,393	14,702	

B.—Bara Bazaar.

Area.	Cost of acquisition.	COST OF RECONSTRUCTION.		Total cost of reconstruction.	Revenue expected.	How calculated.	REMARKS.
		Non-productive.	Productive.				
	Rs.	Rs.	Rs.	Rs.	Rs.		
Kashmiri Mohalla	45,600	2,500	26,858	29,358	3,222	12 per cent on cost.	
Laddaki Mohalla	2,10,000	1,000	1,84,580	1,85,580	11,000	6 " " "	
Old Butcherkhana	4,00,000	1,06,625	2,34,750	3,41,375	28,170	12 " " "	Indian Town Hall 86,625 Walls, etc. ... 20,000
Alley No. 2...	6,945	5,000	...	5,000	...	.....
Pahari Chakla	6,610	600	4,585	5,185	300	A little over 6 per cent on cost.	
Patiala and Maula Bux godowns	3,050	1,500	...	1,500	...	.....
Alley No. 14. Hori Lal's houses and verandah of 95	13,000	3,351	5,000	8,351	600	12 per cent on cost.	
Alley No. 5. Roof only of alley	300	...	...	...	...	.....
Alley No. 13. Sweeper shed and piece of ground adjoining ..	500	...	...	...	...	.....
Alley No. 12. House No. 74, corner only	250	...	...	...	...	.. ..
Middle Bazaar. Shop Nos. 18 and 19	3,600	...	...	...	...	.....
Alley No. 7 ...	44,000	3,000	40,700	43,700	4,070	10 per cent on cost.	
Total	7,33,855	1,23,576	4,96,473	6,20,049	47,362		

C.—Grand Total.

Area.	Cost of acquisition.	Cost of reconstruction.		Total cost of reconstruction.	Revenue expected.	How calculated.
		Non-productive.	Productive.			
	Rs.	Rs.	Rs.	Rs.	Rs.	
Outside bazaars	2,84,146	3,500	1,46,893	1,50,393	14,702	
Bara Bazaar	7,33,855	1,23,576	4,96,473	6,20,049	47,362	
Total	10,18,001	1,27,076	6,43,366	7,70,442	62,064	
Plus 10 per cent additional margin	1,01,800	.....	.....	.....	.....
Total	11,19,801	1,27,076	6,43,366	7,70,442	62,064	

APPENDIX 21.

ON THE SANITARY IMPROVEMENT OF NABHA ESTATE.

Simla, the 3rd September 1914.

FROM

CAPTAIN A. D. STEWART, I.M.S., HEALTH OFFICER,

SIMLA,

To

THE SECRETARY, SIMLA IMPROVEMENT COMMITTEE.

SIR,

WITH reference to your letter No. 64, dated the 17th July 1914, requesting Major Perry and myself to submit a scheme for the sanitary improvement of the Nabha Estate, in my opinion the following deficiencies and defects requiring remedy exist—

- (1) Congestion of buildings.
- (2) Insanitary condition of buildings.
- (3) Deficiency of latrine accommodation and insufficient conservancy.
- (4) Defective arrangement for the disposal of refuse and litter.
- (5) Defective surface drainage within the estate and especially at its boundaries.

The remedies proposed are in synopsis the following :—

I.—The demolition of the following buildings—

- (i) *Building No. 4.*—This consists of three blocks of two-storied buildings. They are unsightly, congested and overcrowded. The lower stories consist of a series of dark rooms built against the khud with little light and no ventilation and they are inhabited by crowds of Ladaki coolies. The upper stories are a series of small ill-lit rooms, occupied for the most part by clerks. Much of the sullage drainage of the upper stories passes down by pipes through the verandahs of the lower stories and collects on the ground underneath. The space behind the buildings is always filthy and apparently regularly used by the coolies as a latrine. Buildings Nos. 3 and 6 are a much better class of house. I therefore recommend the demolition of the whole of No. 4. The resulting space either to be left open or one good-class cottage to be built between Nos. 3 and 6, leaving ample open space on either side of the new building. The whole of No. 4 block was constructed and completed without submitting plans and without the sanction of the Municipal Committee.
- (ii) *Building No. 13.*—This is an ill-constructed two-storied block near the centre of the estate. The rooms of the lower story are small and dark and unfit for human habitation being built below the ground level and having no ventilation. The upper story rooms are small and low roofed. This house was built and completed without submitting plans and without the sanction of the Municipal Committee. Apart from its demolition being called for by its insanitary condition, the site is a desirable one for a flush latrine which is urgently required for the surrounding houses. A case of enteric fever occurred in this block this summer. I would have no objection to a few sanitary servants' quarters being built here if thought necessary.
- (iii) *Building No. 33.*—This is a three-storied building in a very congested part of the estate. The two lower stories consist of rooms built against the khud side.

- (iv) *Building No. 28.*—This consists of two blocks of two-storied buildings close to each other. The lower story is used as cow sheds and stable. I recommend the removal of the upper story of the south block. This in itself is a dirty and insanitary group of rooms with a very broad verandah on its north side. Its removal would allow of the entrance of light and air to the north block.
- (v) *Building No. 30.*—This is in the centre of a congested group of buildings. It was built without the sanction of the Municipal Committee. Its removal is desirable both from its situation and insanitary condition, and also to provide a site for a flush latrine for the surrounding houses.

II.—The rooms of No. 37 block (servants' quarters) and No. 36 and the servants' quarters of No. 14 are all built against the khud side. Those of No. 37, however, are fairly large and many have windows. The rooms of No. 36 are smaller and the fronts are barricaded with iron sheeting which are to be removed. Many of the servants' quarters of No. 14 are small and dark and should be condemned as unfit for human habitation. In many of the houses, for instance Nos. 22, 23, the space between the wall and the hill side has been closed in by planking. This should only be allowed at the places where access to the buildings is actually necessary. The remaining planking should be removed.

III.—Latrine accommodation and conservancy. To provide adequate latrine accommodation for the estate I recommend that flush latrines should be constructed in the following situations:—

- (i) On the site of the present hotel latrine marked L 1 on the plan :—four seated.
- (ii) On the site marked L 2 on the plan :—four seated. This will provide for buildings Nos. 3, 4, 5, 6, and 7.
- (iii) On the site marked L 3 on the plan :—three seated. This will provide for buildings Nos. 21, 22, 23. A ladder from building No. 22 down to this latrine will be necessary.
- (iv) On site marked L 4 on the plan :—two seated. This will provide for No. 25 building which is a large house, accommodating four families.
- (v) On site marked L 5 on the plan :—three seated. This will provide for blocks Nos. 26, 28, and 32.
- (vi) On the site marked L 6 on the plan :—which is on the site of house No. 30 to be demolished :—three seated. This will provide for houses Nos. 29, 31, 34 and possibly No. 35.
- (vii) On the site marked L 7 on the plan :—three seated. This will provide for house No. 37 and servants' quarters.
- (viii) On the site marked L 8 on the plan :—three seated. To provide for block No. 36.
- (ix) On the site marked L 9 on the plan which is on the site of house No. 13 to be demolished :—four seated. This will provide for houses Nos. 9, 10, 11, 14 and 16.

In each of these latrines one compartment should be adapted as a small pail depôt to receive the night soil of the houses. If this is done the erection of a large pail depôt on the estate will be unnecessary.

Should any objections be raised to these sites either in regard to their propinquity or inconvenience an alternative may be suggested in the installation of flush water closets in the houses themselves.

IV.—At present most of the refuse and the litter of the estate is not removed but finds a lodgment in various nooks and crannies throughout the estate. But especially is horse and cow litter dumped at the southern boundary of the estate. The main reasons for this condition of affairs are the great

distance of the nearest incinerator and also the habits of the occupants of the houses. For the effective disposal of all the rubbish and litter of the estate I recommend that two new incinerators be built (1) in the nullah to the eastern side of the estate, and (2) in the corresponding nullah to the western side. The first of these will also serve for the disposal of waste from the railway quarter.

V.—The complete details will be somewhat out of place in this report. The main defects are the insufficiency of pucca drains throughout the estate to take away the sullage, and also the abrupt ending of the through drains at the immediate southern boundary of the estate resulting in a fouling of the ground along the southern vicinity. As examples of deficient surface drainage within the estate, the following may be taken :—

- (1) The sullage drainage of the servants' quarters of the hotel and of the lower story of No. 2 building soaks on to the ground immediately in front. A *pucca* drain will require to be made in front of these buildings and carried along to connect with the cast iron drain in the nullah to the east.
- (2) The drain on the north side of the road above the Post Office which carries sullage water from the hotel and from house No. 37 is at present *kutchā* and will require to be made *pucca*, and led to the cast iron drain mentioned above.
- (3) The drainage from both blocks of No. 28 is defective. *Pucca* drains will be required leading into the drain at the east side which must also be made pucca as far as its connection with the cast iron drain running past the old tank. The drain in front of block No. 37 must be resloped.
- (4) There is no drain in front of No. 36. A *pucca* drain will be required here.

The drains at present ending abruptly along the southern boundary of the estate, for instance at Nos. 23, 26 and 28 and 29 houses, must be made *pucca* for at least a hundred feet down the hill side. Further details regarding surface drainage need not be given at this moment.

I have the honour to be,

SIR,

Your most obedient servant,

A. D. STEWART.

APPENDIX 22.

List of present Dhobi Ghâts and details and estimates for the construction of new Sanitary Dhobi Ghâts.

List of present Dhobi Ghats.

No.	Name of Ghâts.	Approximate number of Dhobies.	Average number of Dhobies daily.	Area of population using chiefly.
<i>Within Municipal Area.</i>				
1	Annandale ...	65	40	<i>Partly for Europeans.—Kaithu and Bara Bazaar.</i>
2	Summer Hill ...	35	20	<i>For Europeans.—Summer Hill, Boileanganj and Viceregal Lodge.</i>
3	Below Monotype Press ...	60	25	<i>For Europeans.—Chaura Maidan, Dhar and Bazaar.</i>
4	Phagli ...	10	6	<i>For Europeans.</i>
5	Sarhan ...	12	8	<i>Partly for Europeans.—Bara Bazaar and Jakko.</i>
	Total ...	182	...	
<i>Outside Municipal Limits.</i>				
1	Below Marlborough house.	20	12	<i>For Europeans.—Chota Simla and Kasumpti.</i>
2	Bishop Cotton School ...	30	18	<i>For Europeans.—Chota Simla.</i>
3	Elysium ...	25	15	<i>For Europeans.—Elysium, Jakko and Snowdon.</i>
	Total ...	75	...	
	GRAND TOTAL ...	257	...	

Statement showing probable cost of constructing Dhobi Ghāts in Simla.

Site No.	Number of Dhobies.	Number of Ghāts required.	Number of quarters required	Cost of Ghāts.	Cost of quarters.	Cost of water-supply.	Cost of land.	Total cost.	Remarks.
1	25	15	5	Rs. 1,200	Rs. 1,000	Rs. 500	Rs. 700	Rs. 3,400	...
2	65	40	12	3,200	2,400	2,300	Nil	7,900	...
3	45	23	8	1,840	1,600	350	1,200	4,990	...
4	60	28	9	2,240	1,800	1,000	1,500	6,540	...
4-A	60	28	9	2,240	1,800	1,000	1,500	6,540	Omitted from total.
5	12	8	3	640	600	1,400	300	2,940	...
6	30	18	6	1,440	1,200	900	750	4,290	..
7	20	12	4	960	800	800	500	3,060	...
...	257	144	47	11,520	9,400	7,250	4,950	33,120	...

APPENDIX 23.

Report by Mr. J. W. Meares on Electric Lifts or Ropeways for Simla.

1. *Preliminary.*—Amongst the proposals before the Simla Improvement Committee are suggestions for means of conveying persons from various low elevations up to the main roads, and I have been asked to report on the question. As I am not a specialist in these matters, except in so far as electricity is employed, I asked the Committee to arrange for a representative of Messrs. George Cradock & Co., to prepare schemes in conjunction with me. They deputed their Engineer Mr. Bradley for this work, which he thoroughly understands. The only other British firm doing this class of work in India are Messrs. Ropeways, Ltd. Their late Engineer, Mr. Underhill, has recently been appointed Forest Engineer to the Government of India. The investigation was greatly delayed by the continuous wet weather experienced, as nothing whatever could be done until topographical and levelling surveys had been completed. By good fortune the former were already in hand, and Mr. French of the Survey of India did everything in his power to complete the latter with the least delay. Even so 3 weeks elapsed before Mr. Bradley was able to start serious work.

2. *Suggested positions.*—The tentative proposals before the Committee included arrangements for connecting the new low level Dhar road with the Mall; similarly connecting the Nabha estate with the Mall; and a lift from Annandale to the Mall. I may add, as a suggestion, that it is possible that a lift from the cart road, past the Combermere bridge, to the neighbourhood of Abergeldie might some day be contemplated. For reasons which I will put down the Dhar lift alone has at present been worked out in any detail; the others can wait.

3. *Systems.*—There are several methods in vogue for lifting passengers or goods up steep slopes, covering a considerable distance. First, there is the plain rack railway, as used in the Nilghirries and Switzerland. Secondly, there is the counterbalance lift, as used at various seaside places in England and also considerably in America. Thirdly, there is the aerial ropeway proper, which can span over considerable valleys. The rack railway is not suitable for any of the present lines, and need not be dealt with further.

4. *Counterbalance lifts—General description.*—The counterbalance type of lift is merely a variety of the vertical passenger lift, adapted to sloping ground. It necessitates a straight track in plan and also a track of very nearly constant slope in section; a small amount of variation in the slope can, however, be allowed if necessary. From these considerations, it follows that a practicable straight line must be found between top and bottom points, suitable for terminals; that this line must be on such an even slope that excessive steel work over valleys or excavation through knolls is not required; and that there must be nothing on the route to interfere with the line. When such a route is found an elevated line has to be erected along it, so as to span clear over roads, railways and the like. A double track line offers the best solution, but it is practicable to have a single track with a turnout for passing cars at the middle point; this, however, offers certain difficulties in the way of disposing of the haulage rope, which must run above the rails, at the point where the cars emerge from the turnouts. The ascending and descending cars run on a rack, with braking devices on the pinion as well as emergency track grips; and a supporting rope connects the two over a drum or pulley at the top. If the power is applied at the top this rope is also the haulage rope; but a separate haulage rope may be employed also connecting the two cars below in cases where the power is applied at the lower terminal. The two cars of course balance each other; if motors are put directly on their

axles, as is sometimes done, these motors also balance one another, but it means so much extra dead weight on the track structure. The load to be dealt with consists of the live load of passengers, the track and other friction, and the excess weight of one side of the rope over the other when the cars are elsewhere than at the centre point of the route. In the seaside lifts referred to the cars are provided with water tanks below, and those on the car about to descend are rapidly filled to such an extent as is necessary to counterbalance the rising load, which is ascertained by speaking tube or telephone. In Simla this method is only practicable if the water is pumped up and used over and over again, as water is a very expensive commodity. That being so, it may prove cheaper to use the power directly on a haulage rope and thus save the pump losses. A combination of the two methods might, however, eventually prove preferable, as the pumping could be done between storage tanks in the night, when power can be supplied at a cheaper rate than during the day. With this system there are only two cars, of fairly large capacity, holding say 30 persons. The speed is about five miles per hour, and when a car has started up the next batch of passengers have to await the arrival of the descending car. Stops at intermediate points can be made, if there are any such required.

5. *Aërial ropeways—General description.*—Where the ground does not admit of a balanced lift, or where the length of route is too great for one, the aërial ropeway is employed; an example, though not a particularly good one, is the freight lift from Simla goods station to the bazar. A similar one on a large scale is to connect Mussoorie with Rajpur. In the past these have been mainly utilized for goods transit, but they are equally applicable to passenger traffic and one such is being erected in Switzerland at present. In this system the nature of the ground is to a great extent immaterial. Terminal points having been chosen, a carrying rope is supported on steel trestles as directly as possible between these points. If, however, difficulty is found in acquiring land the line can deviate from the straight at special angle structures. Long spans can safely be carried over valleys, but nervous people might dislike a method of transit akin to that of a dirigible. By using additional structures, and increasing the expense, the line can be kept near the ground. Small cars are used, carrying about 6 passengers, and these can be started off quickly one after the other. A separate haulage rope runs round the route, and the cars are taken along by this; so to some extent the descending cars assist the ascending cars by gravity. At the terminal points the cars automatically run on to a rail, and are detached from the haulage rope; when empty they are run round the terminal structure by hand, on this rail, and again connected to the rope for the return journey after taking up their freight. The running speed is again about 4 to 5 miles per hour, and the more frequent service more than equalizes the smaller carrying capacity as compared with a lift. The capital cost is also lower with a ropeway.

DHAR LIFT PROJECT.

6. *The Dhar road project—General remarks.*—In connection with the opening out of Dhar spur for clerks' houses the Improvement Committee proposes to construct a road rising on an easy gradient from that village to a point below Simla. Taken by itself the journey from Dhar by this road would land the passenger at a point some 800 feet below the Secretariats. The direct climb is an exceedingly steep one, the angle with the horizontal being about 31° , or say 1 in 1.6. After climbing this in hot weather a man would be wet through, as I can testify from personal experience; and in the rains he would be in much the same plight. If a zig-zag road of 1 in 10 were made up the hill the journey would be one of 8,000 feet ($1\frac{1}{2}$ miles) and would take the best part of an hour. It appears, therefore, that some form of lift is essential to this Dhar project, whether it can be made to pay directly or not. It must be regarded as part and parcel of the road, with a higher capital cost and a higher charge for upkeep, but effecting a great saving of time and labour and also of ordinary roadway.

7. *Dhar project, continued.*—On my arrival in Simla I first looked round for the best method of meeting the needs of the problem. The residents in the area to be opened up are mostly employed in the Secretariats, and they will require to come up within an hour or so in the morning and to go down at intervals after the offices close. A casual scrutiny of the ground showed that a counterbalance lift was possible, and that two practicable routes existed; one running straight down from Alloa Cottage near Kennedy House, and the other running down from the east side of Gorton Castle. Further examination showed that the former of these sites would offer greater constructional difficulties as well as being further from the centre of gravity of various offices; it was therefore abandoned.

We next went down to where the new road passes beneath the various offices, and selected three possible trial sites for a lower terminal station. If a fairly large scale contoured map of Simla had been available it would have been the simplest possible matter to select a route by trial and error on such a map; unfortunately it does not yet exist. However, we obtained from Mr. French a tracing of the plane-table topographical survey of the triangle radiating south from Gorton Castle, and on this we marked the three apparently possible routes. We asked for a longitudinal cross section or profile to be made along each of these routes, at 20-foot intervals. Unfortunately continuous heavy rain interfered seriously with this work, which took over a fortnight instead of about three days. Two of the routes were found to be impracticable after all, but the third is exceptionally good on the whole and we have adopted it for our project.

8. *Dhar lift—Details of route.*—Our first intention was to have the upper terminal of the lift where the office stable to the east of Gorton Castle now stands. From the survey, however, it became evidently preferable to fix on the road immediately below the stable, at the junction of the Kennedy House road with the steep road running from the fire engine station to the cart road. On the lower side of this junction there is good foothold for building up a terminal station (A on the plan) and that level is on the whole quite as good as the upper one. The crossing of these two roads is also saved. The reduced level of this upper terminus is 7,000 feet. The route thence is shown on the attached blue print. The cart road and the railway are crossed with ample headway (especially so the railway).

Immediately below the railway the line comes to ground on a rocky projection (shown at B on the plan), with very steep ground below it. This is at a distance of 346 feet on the slope from the terminus. It is possible that it may be found necessary to construct a big revetment wall from below up to the rock, but that is a matter on which the local engineers will be able to advise when the time comes; it is certainly practicable, and only a matter of ways and means.

From the anchorage at this rock the ground is decidedly bad for about 260 feet measured on the slope, a minor land-slip having recently occurred there. Trouble has evidently been experienced for some time, as the railway (above our line) is carried on a substantial revetment wall, with a protective wall a little further down again. I imagine that this slip will in any case have to be dealt with before long, and it offers no particular difficulty other than expense. We propose carrying our line over this slip on trestles, with a protective wall below if necessary and some surface drainage works would then render the place perfectly secure.

After passing over this ground the line will be in-cutting for a distance of about 347 feet (measured on the slope), the mean depth of excavation being some 12.5 feet and the maximum 20 feet. So far as we can judge without sinking trial pits it is shaly rock, and would come away without much blasting. If, on the other hand, the stone is hard it could be utilized for the revetments. The route here is practically down a spur, so no trouble from water is anticipated. The half-way point of the line is in this cutting, and here the cars cross.

On coming to the surface at 953 feet from the terminus (measured on the slope) there is a slight hollow for some 180 feet (on the slope), which will only

need a low embankment of a few feet in height. Being on the top of the spur this offers no difficulty, although the slope is fairly steep.

The remainder of the line to the foot, *viz.*, 230 feet measured on the slope, is in fairly deep cutting; and it runs parallel and rather close to a small torrent to the west which (at present) is on a higher level than that of our track. Knowing what these small catchment torrents can do on occasion, it is evident that great care must be exercised here. If the line is run right down to the new road level the terminus itself (D on plan) will be in deep cutting (about 20 feet) and there will be a horizontal cutting of some 80 feet to the road. The reduced level here is 6,236 feet, giving a total rise of 764 feet. Even if the stream bed is lowered, which may perhaps be necessary in any case when the road is made, this cutting will I think have to be lined with a revetment wall on the stream side. Further protection by means of boulder crates will be necessary between the stream bed and the cutting. These can be made from the stones in the torrent, thus killing two birds with one stone. After a monsoon this wall, if earth covered, would be protected by undergrowth.

The expense on these protective works would be considerably reduced by placing the terminal at a point some 130 feet (measured on the horizontal) back from the new road centre (C on plan), but there would then be a climb of some 36 feet (vertical) up steps to reach the lift level. The actual reduced level of this upper site is 6,272, giving a rise of 728 feet. Rough alternative estimates have been prepared, to show the difference in cost. The horizontal distance from the top terminal to the centre of the new road is 1,227 feet and the total length of line 1,363 feet.

9. *Power required.*—The starting effort and acceleration up to speed will be taken by the fly-wheel on the motor, coupled with its permissible overload, so it is only necessary to ascertain the maximum and minimum power, positive or negative, required under extreme working conditions. This, expressed in kilowatts taken from the supply will be $\frac{4.45 \text{ W V } (0.45 \text{ T} \pm \text{S})}{\text{E}}$ where

W is the weight of loaded car and rope; V is the speed in miles per hour; T is the friction of the rails, rack and rollers in pounds per ton; S is the gradient; and E is the efficiency of motor and gearing. Taking the latter at 75 per cent the same formula gives the B. H. P. of the motor. We may take the friction as 15 lbs. per ton over all safely; it will probably be less.

The weight below the driving pulley is variable, according to the amount of rope out, *i.e.*, the position of the cars. We have worked on the following data:—

					Tons.
Car alone ...	...	...	...	...	3
Passengers (30 × 150 lbs.)		...	...	...	2
					—
			Loaded car	...	5
Full rope	...	...	...	...	0.8
					—
			Maximum	...	5.8

The gradient S is 61 per cent, so the factor within brackets is $0.45 \times 15 \pm 61$; it varies therefore from 61.6 to 60.4 according to whether the journey is up or down the hill.

We have taken a speed 'V' of 5 miles an hour.

On these data the formula simplifies to—

$$\text{K. W. or B. H. P. up-hill} = \frac{4.45 \times \text{W} \times 5 \times 61.6}{75} = 20 \text{ W.}$$

$$\text{K. W. or B. H. P. down-hill} = \frac{4.45 \times \text{W} \times 5 \times 60.6}{75} = 19.7 \text{ W.}$$

As this formula takes the gradient into account no great error will be introduced by assuming the weight of the rope to be added to the car. The weight 'W' will then be—

				Tons.
Empty car at top	...	...	...	3
Empty car at bottom	...	...	...	3·8
Full car at top	...	...	...	5
Full car at bottom	...	...	...	5·8

The greatest power will evidently be required when a full car is about to start from the bottom, and an empty car to start from the top.

$$\text{K. W. positive } 20 \times 5\cdot8 = +116.$$

$$\text{K. W. negative } 19\cdot7 \times 3 = -59.$$

$$\text{Actual required } +57 \text{ K. W. or B. H. P.}$$

At the end of this journey, when the weight of rope is transferred, we have—

$$\text{K. W. positive } 20 \times 5 = +100.$$

$$\text{K. W. negative } 19\cdot7 \times 3\cdot8 = -75.$$

$$\text{Actual required } +25 \text{ K. W. or B. H. P.}$$

When a full car is descending and hauling up an empty one braking will be necessary or power will be returned to the line; this will be at a negative maximum when the empty car is nearing the top and the full car is nearing the bottom.

$$\text{K. W. positive } 20 \times 3 = +60$$

$$\text{K. W. negative } 19\cdot7 \times 5\cdot8 = -114$$

$$\text{Power returned } -54 \text{ K. W. or B. H. P.}$$

At the end of this journey the rope again comes into play and we have—

$$\text{K. W. positive } 20 \times 3\cdot8 = +76$$

$$\text{K. W. negative } 19\cdot7 \times 5 = -98$$

$$\text{Power returned } -22 \text{ K. W. or B. H. P.}$$

These then are the limits under extreme conditions; ordinarily the balance will be somewhat better no doubt. Working out the matter on ordinary mechanical lines, neglecting the trucks which balance one another, Mr. Bradley finds that the maximum pull on the rope is 4,035 lbs. (less than one-eighth of the breaking strain of the $\frac{7}{8}$ th inch rope he proposes to use). A speed of 5 miles per hour is 440 feet per minute, so the maximum power required will be $\frac{4,035 \times 440}{33,000} = 54 \text{ B. H. P.}$, which agrees practically with the above figures.

10. *Driving arrangements.*—The rope from car to car will pass twice round a 7-foot drum at the top, and its linear speed will be 7·3 feet a second. This gives 1 revolution of pulley in 3 seconds, or 20 revolutions per minute. The pulley will be driven by a 3-phase motor through reduction gearing, with reversing gear and clutch. As the lift will eventually be worked by the Municipal Committee I have consulted their Electrical Engineer (Mr. Milne) and we have come to the conclusion that the considerable power required by the motor can be turned to good account. At present the power factor at which the plant is working is very low, owing to many transformers, etc., and the generators are consequently unable to give their rated output. By running a high tension main (2,200 volts) to a sub-station near the upper terminal and using an over-excited synchronous high tension 3-phase motor, of larger capacity than is actually required, we can not only work the lift but also appreciably raise the power factor of the whole system, increasing the *useful* capacity of

the generators very considerably even when the motor is running light. A small motor generator would supply the exciting current. I have tentatively estimated for such a motor taking 100 kilovolt-amperes with leading current, but of 80 B. H. P. mechanical output for driving purposes, together with its exciting arrangements. A fly-wheel of sufficient size to overcome the inertia at starting will effectually prevent the motor falling out of synchronism when the load comes on.

11. *Control*.—With the arrangement suggested the speed is constant, as the motor is always in step with the generator; but if there happened to be no load whatever on the generators when the lift is returning power to the motor (*i. e.*, with a loaded car on the down grade) their speed might increase. The contingency is not likely, but it was met with on the Valtelina Railway years ago and it can be met. In any case the mechanical braking arrangements on the car must be such that it can be pulled up at once in all circumstances; the rack is provided for this purpose. Good drivers on the cars are of course essential; in addition to the brakes they would have signalling arrangements to the chief driver at the top terminal, who would control the main drive. The stopping at the terminals will be automatic in case of failure on the part of the driver, as in the case of vertical haulages. A pinion on the car will engage with the rack rail, and a hand-brake will control the pinion. In the unlikely event of the rope breaking an arrangement similar to that on ordinary passenger lifts will be provided; the rope will be acting on the car through levers controlled by powerful springs, which in the event of breakage will cause grips to act directly on the track rails. This renders a runaway impossible.

12. *Plans and details of foundations*.—The above general description is supplemented by the topographical plan, prepared by the Survey Department, and is shown more particularly on the attached blue print, prepared by Messrs. Cradock & Co. It represents a profile or cross section of the selected route, and shows the general construction proposed with the lower terminal in the higher of the alternative positions. A continuation of the straight line to the base will indicate the lower position, on the new road level. By good fortune Mr. Bradley has also obtained a photograph which shows the actual lie of the upper part of the lift route clearly. It appears to me probable that in actual construction the excavations can be less deep and the raised construction lower, at least if double track is eventually used; for in that case the rope would sometimes be stretched above rail level, off the rollers, and in others it would be only bearing on the rollers with extra tension, and the wear would be very little increased. The cost of construction would, however, be materially reduced. The centre line of the steel structures or trestles for carrying the line is shown; these have been designed roughly, but the design may need modification and is not put up. The trestles are spaced at 20 feet intervals and consist of 2 legs, one practically vertical and the other at right angles to the line; the maximum possible load on the former component is 3.5 tons and on the latter 1.85 ton.

The concrete foundations for the trestles have been worked on the average slope of the line, *viz.*, 1 in 1.6. In the case of the vertical limb the blocks are 8.75' × 6' × 7' average and 367 cubic feet each. In the case of the other member the blocks are 6.25' × 7' × 2.75' average and 121 cubic feet each. To these we have added 50 per cent for the blocks on the bad ground referred to presently. It will be seen from the profile that special work is required in some places, *e.g.*, at the railway. For the jockey pulleys which have to carry the strain of the rope some 2,250 cubic feet of cement concrete are required, or say 3,000 including the lighter foundations for the motor. At point 340 feet on the plan some 2,250 cubic feet of concrete are required at the anchorage and support.

In the profile the line is shown carried over the bad ground below the railway on a stone wall, as our inspection appeared to indicate this as the cheapest method, and the drawing was made accordingly. On getting out quantities, however, we found that the main wall alone was responsible for

1,10,000 cubic feet costing some Rs. 22,000; this was based on a top width of 15 feet and a rate of Rs. 20 to cover the cost of pointing the outer slope. As however deep foundations, with possibly a low revetment on the lower side, will render trestle work practicable at a lower cost we recast our estimate on these lines. Including the concrete for these foundations, the total of lime concrete amounts to 17,300 cubic feet, with 3,000 cubic feet of cement concrete. The lower hollow does not appear to require a wall at all; we have assumed that it will be banked with spoil from the cutting immediately above; no cost has therefore been entered for this small item.

The excavation in the crest at the middle of the line, assuming a slope of 1 in 1, amounts to 120,000 cubic feet. Similarly at the base, assuming the upper site is chosen for the terminal, the excavation amounts to 110,000 cubic feet, giving a total of 230,000 cubic feet; with the terminal at road level another 115,000 cubic feet must be added. It may be necessary to build a retaining wall on the stream side of this lower cutting—unless it turns out to be very firm ground—so I have added 7,000, and yet another 7,000 cubic feet of dry stone work for this, according to the position of the terminal. The last 150 feet of the line run parallel with the small torrent shown on the plan, and for the present it may be assumed that a line of protective wire boulder-crates will have to be placed between the stream bed and the works. This may be rendered unnecessary by dropping the bed of the stream, but I have added a sum of Rs. 5,000 at a hazard.

13. *Estimates of cost.*—As the Dhar road and the opening up of the area will take a couple of years at least all that is now required is an approximate estimate to show that the project is feasible. The figures are of slide rule accuracy only. Detailed estimates can be obtained from the manufacturers' works in England hereafter. If the project matures an exact survey of the profile, and of the cross sections all along, will be required in order to get out the quantities more exactly. The revetment walls and protective works especially are very treacherous items, and my figures must be taken as no more than a rough guide, which the Public Works Department can hereafter correct on fuller information as to the nature of the ground.

We have, therefore, worked on the assumption that a double track will be used, leaving the feasibility of a single track with a central turn-out to be settled later. A reduction is probable on this account. Any deviation permissible from an even slope will also reduce the cost. From the attached estimate of Messrs. Cradock & Co. approximate figures are taken for the track and supporting steel work, ropes, pulleys, cars and controlling gear. The cars will be arranged for water balancing over the rear axle, but no further arrangements for storage tanks or pumps have been allowed for; if they prove advisable they can be added hereafter. Sea and land freight and charges, insurance, duty and carriage to site have been added at correct rates. To these I have added approximate figures, based on rates supplied by the Municipal Engineer, for the excavation, stone work, foundations and protective works. The Municipal Electrical Engineer has supplied an estimate of the electric lines and sub-station equipment, and I have added the motor arrangements. Erection by Departmental agency, with tools and plant, have been added as a percentage on the total; the figure appears to me excessive for a comparatively simple job. Land acquisition is not included. The result is as follows:—

A.—Putting lower terminal above Dhar Road, as shown on plan.

	Rs.	Rs.
(i) Messrs. Cradock's estimate (attached) for all steel work, etc.	...	...
F. O. B. Birkenhead, £ 2,600	39,000	39,000
(ii) Charges on material. Sea freight Rs. 11 per ton on 97 tons...	1,067	
Landing charges at 1 per cent	390	
Rail freight to Simla, 97 tons at Rs. 15-8	1,503	
Insurance at $\frac{1}{2}$ per cent (exclusive war risk)	195	
Duty at 1 per cent ad valorem (possibly free as Railway material)	390	3,545

	Rs.	Rs.
(iii) Excavation, assumed in soft rock, 230,000 cub. ft. at Rs. 10 per 1,000	2,300	2,300
(iv) Foundations for steel work and anchorage, 17,300 cub. ft. lime concrete at Rs. 30 per cent	5,190	
Foundations at upper terminal, 3,000 cub. ft. cement concrete at Rs. 100	3,000	8,190
(v) Revetment in cutting at lower terminal 7,000 cub. ft. at Rs. 16 per cent	1,120	1,120
(vi) Protective work near stream	5,000	5,000
(vii) High tension line, etc.	3,000	3,000
(viii) Motor, with starting gear, exciting set, control and instruments	4,500	4,500
(ix) Terminal stations and waiting room	3,000	3,000
	<hr/>	<hr/>
Total say	...	69,655
	...	69,700
	<hr/>	<hr/>
Erection, establishment and tools and plant $23\frac{1}{2}$ per cent on Rs. 69,700 ... ..	...	16,380
Contingencies 5 per cent ... ..	...	3,485
	<hr/>	<hr/>
Total	...	89,565
	<hr/>	<hr/>

B.—Putting lower terminal at point on level of new road.

The additions in this case amount roughly to the following:—

	Rs.
On (i)	420
(ii)	35
(iii)	1,150
(iv)	2,000
	<hr/>
Total addition	3,605
	<hr/>

This gives a sum of Rs. 73,300 and adding percentages as before the total cost comes to Rs. 94,000 round. The upper position is recommended.

14. *Traffic*.—At the assumed speed of 5 miles per hour a single journey takes 3 minutes, and allowing 1 minute for emptying and filling the cars this is increased to 4 minutes. The car will hold 30 passengers, and as the main traffic will be all one way this gives 450 passengers per hour in one direction. Probably the total number of clerks normally using the lift would be about 500 on 6 days a week, going up in the morning and down in the evening. Presumably they would be carried free or nearly so. It may be expected, however, that (even after the novelty wears off) a good many people will go down for picnics, etc., as the locality at the base is most attractive. As however the lift is not intended to pay in the ordinary sense, but to be merely a short cut saving miles of roadway, the question of fares can safely stand over.

15. *Annual charges*.—The following allowances appear to be suitable :—

	Rs.
Interest at 4 per cent on Rs. 89,565	3,582
Depreciation at 2½ per cent on Rs. 70,000	1,750
Maintenance at 5 per cent „ „	3,500
Cost of current, net average 20 units an hour, 240 units a day of 12 hours, 87,500 units per annum, at anna 1 ...	5,450
Attendance (under municipal supervisoion, not included) at Rs. 100 per mensem	1,200
Total	15,482 or say Rs. 1,300 per mensem.

The cost of current is merely a book transaction by transfer to another account, and the actual cash paid out will not be large. The project appears to be thoroughly sound. If it were intended to be a paying concern a balance would be struck by receipts of Rs. 43 per diem, or say 344 fares of 2 annas. It is by no means certain that a considerable proportion of this number may not be actually realisable from persons other than those for whom the lift is primarily intended.

OTHER PROPOSED LIFTS.

16. *Nabha Estate lift*.—Mr. O'Grady of the Nabha Estate is anxious to connect up the Estate to the Mall in a similar manner to that dealt with above. A good route exists, from a terminal in front of the Hotel Royal to a point on the Mall below the Retreat, at the west extreme of the servants' houses attached to Woodbank. The scheme is a practicable one, but Mr. O'Grady is afraid that the Estate will have to pay too heavily for the land and wayleaves required; otherwise the Estate would probably pay for the whole concern. I understand that the Simla Improvement Committee do not consider that the lift would be of direct benefit except to the Nabha Estate, and that they are therefore not inclined to recommend public acquisition of land, although they will put no difficulties in the way of the Estate carrying out the improvement at its own expense. The route is being surveyed out for me, but I have taken no further action in the matter. It will perhaps be taken up and estimated for from the plans by Messrs. Cradock and Company later on, should the Nabha Estate so wish.

17. *Annandale lift*.—The lift to Annandale is more or less of a hardy annual. It has been reported on by Colonel Lothbiniere favourably, and by myself in the opposite sense, some years ago. I have no copy of the papers now, but I believe they will be found in the office of the Military Secretary to the Viceroy. My recollection is that a fare of at least 1 rupee a journey was necessary, a sum which few would be inclined to pay. As the line would only benefit Simla very indirectly, if at all, it ought to be a paying proposition to be taken up. Having put these views personally before a meeting of the Simla Improvement Committee it was understood that the matter need not be proceeded with at present. I may add however that a counter-balance lift would, even if practicable, be useless; the upward traffic is very congested, and people would not be prepared to go up about 30 at a time at intervals of 5 minutes. One can walk up in half an hour, and it might be necessary to wait a couple of hours for a seat. An aerial ropeway would here be both cheaper and better, and might almost prove self-supporting when passengers were used to the sensation of being suspended on a rope in mid-air. With the aid of a contour map of the area between Annandale and the Mall, from Gorton Castle to Chaura Maidan, rough estimates can be prepared by Messrs. Cradock and Co. if desired. Personally I do not think it is worth while for the Committee to take up the question.

18. *Combermere lift*.—If the Dhar lift is built the utility of such lines will be fully established, and others will almost certainly follow. I have mentioned

a site for one such which would certainly meet a want and would probably pay. It would run from the Cart Road to near Abergeldie, with stations at the Combermere bridge, the Club, the tennis courts, and on the Upper Jakko road. There is no reason why such a lift should not take up rickshaws on a rear platform, and thus avoid the very steep hill near the Church. It will be time, however, to consider this when a start has been made with the Dhar lift and actual figures are available. From a rough examination I think the two would cost about the same.

Dated Simla, the 7th September 1914.

J. W. MEARES, *M.I.C.E.*,
Electrical Adviser,
Government of India.

APPENDIX 24.

Notes by Mr. J. W. Meares on mechanical passenger transport for Simla.

INTRODUCTORY REMARKS.

1. *Length of route.*—At the request of the Simla Improvement Committee and Mr. Nethersole I have made a rough estimate of the probable cost of mechanical traction on the Mall from the Chota Simla Post Office to the guard house below Viceregal Lodge; the distance between these points is roughly $3\frac{1}{2}$ miles.

2. *Alternative solutions.*—The problem may be dealt with by 3 methods, viz.—

- (a) an ordinary electric tramway, with overhead wires and rail return.
- (b) railless electric traction, *i. e.*, motor cars with double trolley and double overhead line, and no rail track.
- (c) battery driven self-contained cars.

3. *Advantages and disadvantages.*—The initial cost will be in the order given, a tramway being the most costly. On the other hand the running charges will probably be in the inverse order. Both (a) and (b) involve a continuous web of wires throughout the whole route, as the trolley wires would, for the most part, have to be carried from span wires suspended from steel poles on both sides of the road; a certain amount of bracket construction might be possible, but this is not much more sightly and would be difficult to construct, owing to the fact that the whole line would consist of curves. In addition (a) involves a track of girder rails together with turnouts for passing cars at intervals; at these points practically the whole width of the road would be occupied. Both methods involve large car sheds, with overhead lines in them for which it would perhaps be difficult to find space. In favour of method (c) there is a good deal to be said. There would be an entire absence of sparking on trolley wire and rail, which would be apt to frighten horses at first. The service could be started with a few trial cars, and subsequently added to gradually as required; and such alterations in carrying capacity or construction as experience dictated could be incorporated in subsequent cars.

4. *Side slip.*—Both methods (b) and (c) have the great disadvantage that side slip would be both possible and probable on the steeper gradients, and indeed everywhere in wet weather. Even if oiling the roads were stopped altogether the hills above the Combermere bridge and the Central Telegraph Office would be dangerous; and regrading would be only possible to a very limited extent.

5. *Power available.*—Three phase alternating current at 50 periods per second and 380-220 volts is available in Simla. Methods (a) and (b) could be worked on this system, but it would involve two trolley wires and a rail return for (a) and three trolley wires for (b). For this reason it would be preferable to put in a converter sub-station giving continuous current at the usual pressure of 500 volts, reducing the requirements to a single trolley wire and rail return for (a) and a double trolley wire for (b). The self-contained system (c) involves batteries, so a continuous current charging station, worked from the supply through a converter, would be required.

SYSTEM (a). ELECTRIC TRAMWAY.

6. *Track, turn-outs, etc.*—In the route length of $3\frac{1}{2}$ miles it would be necessary to provide double track turn-outs at intervals of about $\frac{1}{2}$ a mile or say 6 in all, for passing cars in opposite directions. These should be as evenly spaced as possible, to prevent traffic delays. They would be situated somewhat as follows:—(1) Erneston (2) Chalet (3) Combermere bridge, (4) Telegraph Office (5) Secretariat (6) Chaura Maidan. A site would also have

to be found on the route for car sheds (with track and overhead lines) and for repair shops. The sub-station would be placed at Idgah, where the Chaba transmission lines end.

7. *Speed and service.*—We may assume an average *running* speed of 6 miles per hour or say 32 minutes from end to end. This sounds low, but it is unlikely to be exceeded; in fact it is no higher on several lines in Calcutta and on many British tramways. The maximum could only safely exceed 8 miles per hour on the few level pieces that are fairly wide. As exact regularity is impracticable one car will almost invariably have to wait for another at the turn-outs. Taking these stops at 1 minute each, or 6 minutes in all, the single journey will occupy 38 minutes, which is perhaps a little quicker than a rickshaw. The number of cars in actual service (at the hours of maximum traffic) will be 14, *viz*: 12 at the 6 turn-outs and one at each terminal; this presupposes that there will be a siding at each terminal, so that the outgoing loaded car can start off while the incoming car is discharging its passengers. The cars will be double ended, so that they do not require to be turned round. Thus a car will start every 5 minutes during the busy hours of going to and from office, while a 10 minute service would suffice during most of the day and in the off season—assuming any service to be required then. The cars could stop to take up and set down at points between the turn-outs, but these should preferably be fixed; otherwise there would be no regularity in the service. Suitable half way points, where roads come in, are at Fitzroy Villa, “Khaibar Pass”, Town Hall, Army headquarters, Kennedy House, Foreign Office.

8. *Carrying capacity.*—Assuming that the cars hold about 24 passengers and start at 5 minutes intervals the line will carry 288 passengers an hour in one direction. This should be sufficient. The traffic will be heaviest between the Government of India offices and the town, and will be mostly in one direction according to the time of day. Small cars are evidently necessary, and if they are divided into 2 classes the cars will probably not fill so well. The better class of Indian travels in the first class cars in Calcutta without friction; in Bombay, on the other hand, Europeans hardly use the cars at all, as they are apt to be unclean. It is questionable whether ladies would travel much in the Simla cars.

9. *Track, grades and power required.*—There is no room for standard gauge track; metre or 3' 6" would be necessary. Narrower gauges are almost impracticable for motor driven cars. The cars should be single deck, single truck cars, with two motors—one on each axle—to allow of series-parallel control. The really heavy gradients (about 8 per cent) are of such short length that the overload capacity of the motors will carry the cars up them. The levels and average gradients are approximately as follows:—

—				Approximate altitude, feet.	Rise or fall, feet.	Length, feet.	Average gradient.	
Terminus, Chota Simla Post Office	...			7,000	+120	4,000	1 in 33	3%
Oakover	...	...	...	7,120				
Chalet	...	...	...	7,060	—60	2,000	1 in 33	3%
Combermere bridge	...	...	...	7,121	+61	2,000	1 in 33	3%
Town Hall	..	...	...	7,206	+85	2,000	1 in 23½	4½%
Below Gorton Castle	...	...	...	7,090	—206	3,000	1 in 14½	6½%
Terminus below guard house, V. L.	...			6,890	—110	5,500	1 in 50	2%
Total				...	...	18,500	...	...

The short steep slope down to the Combermere bridge, with its sharp turn at the foot, is dangerous. It would be possible to raise the roadway down to about " " Spink's by reconstructing the bridge, and thus to get the turn on comparatively level track. The loaded car and equipment may be taken to weigh about 8 tons (possibly less) and to require two 10 B. H. P. traction motors; these are capable of exerting double that power for short periods. To run up these cars from rest, on the steeper gradients, would require about 35 kilowatts from the line. Each car trip (one way) is equivalent to 25 ton miles, and taking the average consumption at .16 units per ton mile this comes to about 4 "units" per journey or 8 "units," per round trip of just over one hour. That is equivalent to an average of only about 8 kilowatts from the line (say 8 B. H. P. on the car), but this is accounted for by the fact that half the trip is down hill and requires no power at all.

10. *Units per hour and sub-station power.*—The 14 cars in simultaneous use will therefore use about 112 units per hour. The sub-station plant however must be capable of supplying the power to *start* at least half of the cars (those on uphill grades) almost simultaneously, as they are evenly spaced on the turn-outs. The total power in the sub-station must, therefore, be about 7×35 or say 250 kilowatts. This is the full capacity of each of the (absurdly small) generating sets at Chaba.

11. *Total units and cost of power.*—If we assume a full service for 4 hours a day and a half service for a further 6 hours a day the total daily units will be $448 + 336 = 784$. Such a service may run on 6 days a week for some 30 weeks or 180 days, giving a total consumption of 140,000 units a year. The Sunday service would not amount to much; this with a cold weather service might increase the consumption to 200,000 units. There would not be much demand in the winter; heating the cars would also be necessary, and would run up the cost. As however the staff would have to be kept on and the capital charges are the chief item of expense it would pay to run the cars in winter even for very small traffic. The power required is not at present available at Chaba and will possibly not be wholly available from the first extension; a second extension could however deal with it. The cost of energy for project purposes may be taken at 2 annas a unit or (for 200,000 units) Rs. 25,000.

12. *Capital cost.*—A rough estimate of the capital cost of the project will be as follows:—

	Rs.
Track (3' 6" gauge, 75 lb. grooved girder rails on cement concrete bed; Macadam surface) $3\frac{1}{2}$ miles including turn-outs, etc.	1,50,000
"Bonding" return circuit, $3\frac{1}{2}$ miles at Rs. 2,000 per mile ...	7,000
Overhead construction, $3\frac{1}{2}$ miles at Rs. 12,000	42,000
16 cars (2 spare) at Rs. 9,000	1,44,000
Line feeders	10,000
Main feeders	25,000
Sub-station equipment 250 kilowatts, in duplicate	30,000
Car sheds, repair shops, etc.	20,000
Total	4,28,000
Contingencies at 7 per cent	30,000
Grand Total	4,58,000
Say, Total	4,60,000 round.

This does not include any land acquisition for car sheds.

13. *Annual charges.*—An all round figure of at least 15 per cent. for interest, depreciation and maintenance must be taken into account. The annual charges may then be taken somewhat as follows :—

	Rs.
Capital charges at 15 per cent.	69,000
Cost of current (paragraph 11)	25,000
Wages of drivers and conductors, and sub-station attendant say 33 at Rs. 25 per mensem average ; say ...	10,000 round.
Engineer-Manager, clerical establishment, repair fitters, lines- man, etc., Rs. 1,000 per mensem	12,000
Total ...	1,16,000

14. *Passengers carried and fares.*—Taking the car service foreshadowed in paragraph 7, and the cars mentioned in paragraph 8, an estimate of passengers carried may now be made. The full service is capable of carrying 576 passengers an hour in both directions, but the cars will never be full both ways. Assume that there is the full 5 minute service for 4 hours a day, carrying 250 passengers per hour or 1,000 in all. A 10 minute service during the rest of the day will carry 288 passengers an hour running full, but the number would not average more than 70 at the outside. For 6 hours this is 420 passengers, making 1,420 in all per day. During the 180 week days taken in paragraph 11 this means 256,000 passengers. For reasons given above a winter service would be kept up and also a limited service on Sunday. We may estimate another 50,000 passengers for these services or in round figures 300,000 passengers per annum. This appears to be an outside figure. Just to cover the annual charges of Rs. 11,600 (paragraph 13) would on these assumptions mean a fare of over 6 annas. This is cheaper than a rickshaw, but very much more expensive than walking ; a double journey daily would cost over Rs. 20 per mensem. To get down to the ordinary Indian fare of 2 annas a journey the annual charges would have to be reduced to one third of those shown, and the reduction of say Rs. 40,000 would have to come almost entirely off the capital charges, reducing them to Rs. 29,000. This at 15 per cent means a capital cost of under 2 lakhs for the scheme which is an impossible figure.

SYSTEM (b). RAILLESS TRACTION.

15. *Capital cost on same assumptions.*—For the sake of comparison the same data will be used as in the case of the tramway, where applicable.

The cost of track and bonding is saved, but a double trolley wire is required. The capital cost may then be estimated as follows :—

	Rs.	Rs.
Cost of tramway (excluding contingencies) ...	...	4,29,000
“ Deduct track... ..	1,50,000	
“ bonding	7,000	
Gross deductions	1,57,000	
Extra for double trolley line and extra trolley on cars ...	15,000	
Net deduction	1,42,000	1,42,000
Total ... ..	...	2,87,000
Contingencies at 7 per cent ... ..	...	20,000
Grand total ... ..	...	3,07,000

16. *Annual charges, and consequent fares.*—The current consumption will be somewhat higher, as the average power required will be greater. Tyres will also come in with heavy renewals. On the other hand the heavy track expenditure disappears and an allround charge of 14 per cent instead of 15 per cent may be taken. The annual charges may be taken as follows :—

				Rs.
Capital charges at 14 per cent	...	...	...	43,000
Cost of current	...	...	...	30,000
Wages and management as before	...	...	...	22,000
Total Rs.				95,000

This involves a 5 anna single fare on the previously assumed traffic. The average speed would probably be lower than with the tramway, as side slip on some parts of the road would spell disaster.

SYSTEM (c). SELF CONTAINED CARS.

17. *General remarks.*—I did not mention petrol driven cars or buses in my introductory remarks as it is unlikely that they would ever be introduced in Simla. Electric cars are more expensive than petrol cars in first cost, but they have the advantage of being absolutely silent and without smoke or smell. They are also very easy to drive and control. In the United States of America enormous numbers of electric passenger cars and motor lorries are now used, and efforts are being made to introduce them more extensively into the United Kingdom. The electric supply companies are taking the lead in this matter, as the charging of batteries during the hours of light load is very profitable even at very low rates. This feature of the scheme applies to Simla also. Whereas systems (a) and (b) must have power from the mains when they are running, most of the charging of battery cars could be done in the general garage at night. They could probably do a day's work on one charge. So long as the lead accumulator was the only practicable means of storage, battery cars were a failure; the Edison nickel-iron-potash cell is far more hardy in construction and will stand much worse electrical treatment also. At the same time, on roads like the Mall in Simla, it would be somewhat of a novel proposition. That small 2 seated cars would be successful I have no doubt, but heavy omnibuses plying for hire are by no means so certain to prophesy about. They could, however, be introduced gradually and experimentally, and they would not be confined to the Upper Mall. The main bazar road and the Mashobra roads would be within their capacity.

18. *Capital cost.*—I can do little more than guess the cost of a Mall service corresponding after the initial period of trial to that in systems (a) and (b), as no prices are available. Probably £800 to £1,000 per car would not be far wrong for the same capacity. Taking the higher figure and the same number of cars we have :—

				Rs.
16 cars at Rs. 15,000	...	...	...	2,40,000
Sub-station charging equipment of 100 k.w., in duplicate	...	...	...	14,000
Charging garage	...	...	...	20,000
Total				2,74,000
or with contingencies say				2,80,000

19. *Annual charges.*—The depreciation would here be very heavy, and 18 per cent would probably not be too much to allow—certainly on all the earlier cars. Allowing for the charging losses the total power used would probably be at least half as much again as with the trackless trolley cars, but

it could be supplied at about half the rate. Higher wages would about balance lower supervision. Using these assumptions:—

				Rs.
Capital charges at 18 per cent	...	...	...	50,500
Cost of current	...	...	...	22,000
Wages and management as before	...	...	...	22,000
Total				94,500

This is practically identical with the figure arrived at for railless traction, but owing to these cars not being restricted to a particular route they would probably earn a greater revenue; they could be run wherever a demand existed at the moment. Even so the paying fare would be not less than 4 annas. These cars when running down hill would be able to re-charge their cells to some extent, giving a regenerative braking effect and at the same time saving wear and tear on the ordinary brakes. I have not taken this into account, and it might reduce the cost of current about Rs. 5,000. It would certainly increase the length of time a car could keep going without returning to the garage.

20. *Battery cars on rails.*—Hitherto battery operated tramways have never been a financial success, but I believe they may yet pay some day; in Simla I fear they would not. If this system were adopted the side slip difficulty would vanish, but the cost of track would have to be taken into account. The overhead lines and bonding of track, and the feeders and distributors, would be unnecessary. The cost would be somewhat as follows:—

				Rs.
Track as in paragraph 12	...	...	...	1,50,000
16 cars at Rs. 12,000	...	...	...	1,92,000
Sub-station plant as in paragraph 18	...	...	...	14,000
Garage as in paragraph 18	...	...	...	20,000
				3,76,000
Contingencies				14,000
Total				3,90,000

The annual charges may be taken at 17 per cent or Rs. 66,400; cost of current Rs. 20,000; wages and supervision as before, Rs. 22,000; total Rs. 108,400.

CONCLUSIONS.

21. *Motor rickshaws.*—As commercial propositions none of these methods appear to be feasible. It must be remembered that public road vehicles generally have several varieties of traffic, *viz.*, (a) that of people going to and returning from office, morning and evening, (b) that of transit between offices or for shopping during the day, (c) special traffic to such places as race courses, golf links, places of worship, etc. This last class is a very paying one and is practically absent in Simla. Furthermore (and this is so even with automobile public cars) the branch roads off the main track in Simla are for the most part too steep and too narrow for any vehicle other than a rickshaw; even the self-propelled rickshaw would offer difficulties, for it would probably have to be 4-wheeled, with a fair wheel base and wide gauge, to avoid overturning at corners. The roads up Jakko and the other hills and down the Lakkar Bazar or Chota Simla would probably require a prohibitive weight of batteries even for a 2 seater, and would want a very careful driver into the bargain. Even ordinary rickshaws occasionally take charge and run away. Persons travelling off the main route would therefore require their ordinary rickshaws as at present, as the great majority of houses that Europeans would wish to get to are at some distance above or below the main roads. Indians would for the most part be unable to afford the fares which alone could make any system remunerative.

Coming down once more to the motor rickshaw, there is unquestionably scope for this but *at first* it would cost at least as much as a Ford car or say Rs. 2,500. It would be of entirely novel design, involving new "patterns" throughout, and the earlier buyers would have to pay for standardizing. Eventually the cost would come down to about Rs. 1,200 probably. Such cars would perhaps be able to run from 50 to 70 miles on a single charge, including regenerative down-hill mileage, so that they would ordinarily only need attention at the garage about twice a week. High speeds would necessarily be prohibited, but the climbing power would have to be good for roads running up 1 in 12 at least, on occasion. The cost of recharging would probably not exceed Rs. 3. Taking the capital charges as 20 per cent these, on a cost of Rs. 1,200, would amount to Rs. 20 per mensem. If the Municipality or some enterprising hotel would get out a few for hiring purposes they would almost certainly pay, because of their novelty; and the experience gained with them would result in rapid improvement. It is unlikely that private persons will purchase until they have had ocular proof of their practicability. For opening up Mashobra, Mahasu and Summer Hill these might prove exceedingly valuable. The proposal was first made by the late Mr. Ducane Smythe (Chief Engineer, Public Works Department, Punjab) at the time of the last Simla Improvement Committee. At that time battery cars were impracticable; they are no longer so.

J. W. MEARES, M.I.C.E.,

Electrical Adviser, Government of India.

Dated Simla, the 26th August 1914.

APPENDIX 25.

I.—Statement showing details regarding the residence of European employés.

Departments	Main Bazar.	Kaibhu.	Sanjauli.	Chota Simla.	Kasumpti.	Dhar.	Boteaugauy.	Elysium Hill.	Miscellaneous.	Total	Number residing in Government quarters.	Number residing in private quarters.	Total number of dependants in Simla.
Home Department	4	5	...	...	...	2	...	...	9	20	7	13	47
Director-General, Indian Medical Service	1	3	...	2	...	...	...	1	3	10	1	9	24
Director, Criminal Intelligence	...	1	...	3	...	...	...	2	12	18	...	18	12
Education Department	...	1	...	...	...	...	1	...	9	11	...	11	7
Legislative Department	...	3	...	1	...	...	...	1	4	9	1	8	9
Foreign and Political Department	1	10	...	1	...	2	6	1	27	48	17	31	99
Inspector-General, Imperial Service Troops	1	1	...	1	...	...	...	...	...	3	1	2	6
Revenue Department	...	4	...	...	...	...	...	...	16	20	3	17	53
Survey of India Department	...	2	...	1	...	1	...	...	3	7	1	6	10
Commerce Department	...	4	...	1	...	...	...	...	11	16	...	16	24
Director-General, Posts and Telegraphs	...	2	...	...	...	...	...	1	3	6	...	6	8
Government Central Press	10	...	...	...	...	...	...	...	...	10	...	10	10
Government Monotype Press	...	...	...	...	...	3	1	...	...	4	1	3	11
Railway Department	1	9	...	...	...	2	...	...	6	18	6	12	43
Accountant-General, Railways	...	1	...	...	...	...	...	...	15	16	2	14	31
Public Works Department	1	8	...	4	1	1	...	...	6	21	7	14	33
Consulting Architect to the Government of India	...	...	...	...	...	1	...	1	3	5	2	3	6
Imperial Sub-Division	...	...	...	1	...	...	...	...	...	1	...	1	1
Finance Department	...	2	1	...	...	...	...	...	3	6	...	6	11
Military Finance...	...	1	...	...	...	...	...	1	2	4	1	3	3
Military Accountant-General	1	...	...	...	...	...	...	...	3	4	...	4	10
Army Department	...	8	...	1	...	...	...	...	19	28	2	26	53
General Staff Branch	...	5	1	2	...	...	...	2	32	42	4	38	82
Medical Branch	...	1	...	2	...	...	...	...	5	8	1	7	23
Ordnance Branch	3	2	...	3	...	1	...	...	8	17	1	16	33
Military Works Branch	...	1	...	2	1	1	...	...	13	18	...	18	33
Adjutant-General's Branch	...	...	...	2	1	1	1	...	23	23	1	27	23
Quarter Master-General's Branch	5	6	3	3	1	...	1	1	27	47	2	45	35
Military Secretary's Branch	...	3	...	2	...	...	...	...	4	9	1	8	19
Punjab Civil Secretariat	...	...	...	4	...	...	...	...	3	7	1	6	17
Public Works Department, Punjab	...	1	...	...	...	...	...	1	9	11	...	11	9
Financial Commissioner	...	...	...	2	...	...	...	...	1	3	...	3	8
Inspector-General of Civil Hospitals and Chief Plague Medical Officer.	...	...	...	1	...	...	...	...	...	1	...	1	3
Inspector-General of Police	...	...	...	...	...	...	...	1	...	1	...	1	4
Director of Public Instruction	1	...	...	...	...	...	...	...	...	1	...	1	2
Inspector-General of Prisons	1	...	...	...	...	...	...	...	...	1	...	1	2
Simla Municipality	1	1	1	1	...	...	...	...	7	11	1	10	31
Office of the Private Secretary to His Excellency the Viceroy	...	...	...	...	...	...	1	...	2	3	1	2	2
Office of the Military Secretary to His Excellency the Viceroy	...	...	...	1	...	...	...	...	...	1	...	1	5
Total	31	85	6	41	4	15	11	13	288	494	65	429	847

II.—Statement showing details regarding the residence of Indian employes.

Department.	Main Beazar.	Katru.	Sanyauli.	Chota Simla.	Kasumpti.	Dhar.	Bulleanganj.	Rly-stn Hill.	Miscellaneous.	Total.	Number residing in Government quarters.	Number residing in private quarters.	Total number of dependants in Simla.
Home Department	7	...	4	...	...	...	3	...	9	23	...	23	76
Director-General, Indian Medical Service ..	11	2	...	2	...	...	1	2	7	25	...	25	93
Director, Criminal Intelligence	7	1	1	...	...	...	2	...	5	16	...	16	57
Education Department	9	...	2	1	...	...	1	1	9	23	2	21	79
Director-General of Archaeology	5	1	1	4	2	...	...	...	...	13	...	13	14
Legislative Department	3	1	1	2	...	...	...	...	4	11	2	9	42
Foreign and Political Department	10	2	...	...	...	...	3	...	14	20	1	29	107
Foreign and Political Department Press ...	...	...	...	...	...	...	2	...	35	37	31	6	42
Inspector-General, Imperial Service Troops ...	1	...	...	...	...	...	...	...	...	1	...	1	1
Revenue Department	15	5	4	...	...	...	2	1	6	33	1	32	138
Meteorological Department	19	1	2	...	...	1	3	4	14	44	1	43	100
Survey of India Department... ..	9	2	4	1	1	...	...	8	2	27	...	27	54
Commerce Department	15	2	8	2	...	1	1	1	16	46	4	42	121
Director-General, Posts and Telegraphs ...	10	4	1	...	...	...	...	...	5	20	4	16	43
Chief Inspector of Explosives	3	...	...	...	...	...	...	...	3	6	2	4	17
Government Central Press	250	23	5	3	3	4	3	4	11	303	1	804	839
Government Monotype Press	54	3	...	9	...	64	13	...	13	156	7	119	228
Railway Department	18	2	3	3	1	5	...	2	25	59	1	58	210
Accountant-General, Railways	14	...	2	1	...	1	1	...	4	23	...	23	80
Public Works Department	12	4	...	2	...	1	...	...	4	23	...	23	95
Consulting Architect to the Government of India	...	1	...	...	...	...	...	...	5	6	...	6	22
Imperial Sub-Division	2	1	...	2	...	1	...	2	...	8	1	7	9
Finance Department	14	2	2	2	...	3	10	...	22	55	4	51	132
Military Finance	5	2	...	...	...	...	...	...	5	12	1	11	40
Military Accountant General	15	2	12	1	...	...	1	...	6	37	8	34	93
Army Department	8	...	2	4	...	...	...	...	14	26	2	24	65
General Staff Branch	5	1	...	...	...	...	...	1	...	7	...	7	15
Medical Branch	12	1	3	1	...	...	1	1	3	22	...	22	89
Ordnance Branch... ..	13	...	3	2	...	1	...	...	19	38	2	36	108
Military Works Branch	14	1	2	1	1	2	...	1	11	33	...	33	135
Adjutant General's Branch	15	...	...	...	...	...	...	...	6	21	...	21	71
Quartermaster-General's Branch	17	1	...	3	...	2	...	...	6	29	...	29	130
Military Secretary's Branch	4	1	...	...	...	...	1	...	2	8	...	8	31
Punjab Civil Secretariat	1	...	2	2	4	...	...	...	2	11	...	11	28
Office of the Private Secretary to the Lieutenant-Governor	...	...	1	3	...	...	...	...	...	4	2	2	15
Public Works Department, Punjab	3	...	3	7	12	...	...	...	...	25	...	25	102
Financial Commissioner	1	...	...	...	2	...	...	...	...	3	...	3	7
Inspector-General of Civil Hospitals and Chief Plague Medical Officer.	...	...	...	...	3	...	...	...	1	4	...	4	7
Inspector-General of Police	1	...	...	...	1	...	...	1	...	3	...	3	5
Director of Public Instruction ... ..	...	...	1	...	1	...	...	...	1	3	...	3	11
Legal Remembrancer	1	...	...	...	...	...	...	...	1	2	...	2	6
Director of Agriculture and Industries ...	1	...	...	...	...	...	...	...	...	1	...	1	...
Commissioner, Ambala Division ... ..	...	...	...	...	...	...	...	...	1	1	...	1	...
District Court, Simla	20	4	2	...	...	...	1	1	1	29	1	28	102
Punjab Secretariat Press ... ..	...	...	...	2	18	...	...	...	2	22	...	22	17
Simla Municipality	27	7	1	...	...	1	1	1	14	53	...	52	98
Office of the Private Secretary to His Excellency the Viceroy ...	1	...	...	...	...	...	4	...	1	6	...	6	16
Press establishment of the Private Secretary to His Excellency the Viceroy.	...	...	...	...	...	...	6	...	23	29	19	10	61
Office of the Military Secretary to His Excellency the Viceroy ...	2	...	...	...	...	...	15	...	1	18	...	18	77
Total	652	76	72	60	49	87	75	81	383	1,435	92	1,343	4,056

APPENDIX 26.

TOTAL COST OF ALL PROJECTS.

					Rs.
1	Water	...	...	...	6,50,000
2	Sewage	..	...	...	6,80,000
3	Drainage, ravines and nullahs	...	...	...	1,60,075
4	Destructor and covering chute	..	...	...	35,000
5	New incinerators	...	...	...	17,500
6	Dhobi Ghats	...	...	...	40,000
7	Disinfectors	...	...	...	10,000
8	Church Road	...	...	...	75,000
9	Improving cart road to Sarhan Road	...	..	...	3,000
10	Acquisition of land at Dhar	...	...	...	1,61,000
11	Dhar Phagli Road	...	...	...	20,000
12	Lift	...	...	...	1,00,000
13	Acquisition of Bazaars	$\left. \begin{array}{l} 10,18,001 \\ \text{plus } 10\% \\ 1,01,800 \end{array} \right\}$			11,19,801
14	Reconstruction	...	...	...	7,70,442
Total Rs.					38,50,818

APPENDIX 27.

SIMLA MUNICIPALITY.

Income.—Actuals for 1913-14 and forecast from 1914-15 to 1922-23.

(In thousands of rupees.)

	1913-14.	1914-15.	1915-16.	1916-17.	1917-18.	1918-19.	1919-20.	1920-21.	1921-22.	1922-23.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1. Octroi (net)	2,02	2,02	2,36	2,36	2,36	2,36	2,36	2,36	2,36	2,36
2. Ground tax	28	28	35	35	35	35	35	35	35	35
3. House tax	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80	1,80
4. Water tax	37	37	37	37	37	37	37	37	37	37
5. Conservancy tax	50	...	...	...	...	...	...	...	...	...
6. Dog tax	5	5	5	5	5	5	5	5	5	5
7. Animal and vehicle tax	10	10	10	10	10	10	10	10	10	10
8. Rents	41	41	38	38	38	45	45	45	45	45
9. Forests	57	57	...	...	...	...	...	...	...	...
10. Sale of water taken in excess of free allowance	28	28	28	28	28	28	28	28	28	28
11. Licenses	4	4	4	4	4	4	4	4	4	4
12. Hospitals	7	7	7	7	7	7	7	7	7	7
13. Schools	2	2	2	2	2	2	2	2	2	2
14. Contribution from Government	12	9	10	10	10	10	10	10	10	10
15. Sundry items	70	50	50	50	50	50	50	50	50	50
16. Total	7,33	6,60	6,42	6,42	6,42	6,49	6,49	6,49	6,49	6,49
17. Reduction in cash balance	44	...	...	...	...	...	...	..	...	...
18. Add Electricity Department income from official and private consumers and house connections	24	58	76	1,04	1,13	1,18	1,25	1,25	1,25	1,25
19. Income A	8,01	7,18	7,18	7,46	7,55	7,67	7,74	7,74	7,74	7,74
20. Add 50 per cent on Electricity Department tariff and contract rates, from 1st May 1915 ... ..	...	...	36	50	56	59	62	62	62	62
21. Total income B	8,01	7,18	7,54	7,96	8,11	8,26	8,36	8,36	8,36	8,36

SIMLA MUNICIPALITY.

Charges—actuals for 1913-14 and forecast from 1914-15 to 1922-23.

(In thousands of rupees.)

	1913-14.	1914-15.	1915-16.	1916-17.	1917-18.	1918-19.	1919-20.	1920-21.	1921-22.	1922-23.
1. General Administration and collection ...	53	55	60	58	58	59	59	60	60	60
2. Fire	12	12	15	15	15	15	15	15	15	15
3. Lighting	15	15	13	10	5	4	4	4	4	4
4. Water Works Maintenance ...	81	65	60	60	60	60	70	70	70	70
5. Sewage and Drainage Maintenance ...	14	14	14	14	15	16	17	17	18	18
6. Conservancy	52	52	52	52	43	42	40	40	40	40
7. Hospitals	35	35	35	35	35	35	35	35	35	35
8. Schools	10	10	10	10	10	10	10	10	10	10
9. Forests	33	33	2	2	2	2	2	2	2	2
10. Public Works Maintenance ...	1,09	1,05	1,05	1,05	1,05	1,05	1,05	1,10	1,10	1,10
11. Reduction of debt (Municipal) ...	1,06	1,17	1,17	1,17	1,17	1,17	1,05	62	40	40
12. Reduction of debt (Electric Department) ...	...	3	10	20	20	20	20	20	20	20
13. Capital outlay on buildings, water-supply and sewerage.	1,26	40	40	33	31	38	40	40	40	40
14. Sundry items	73	67	67	67	67	67	67	67	67	67
15. Depreciation of electric plant at Chair and Cherot Nala.	...	...	10	10	10	10	15	30	34	34
16. Total ...	7,19	6,23	6,10	6,08	5,93	6,00	6,04	5,82	5,65	5,65
17. Add Electricity Department charges (excluding loans <i>vide</i> item 12.	80	93	1,03	1,34	1,58	1,63	1,27	1,27	1,27	1,27
18. Total charges ...	7,99	7,16	7,13	7,42	7,51	7,63	7,31	7,09	6,92	6,92
19. Surplus A.	2	2	5	4	4	4	43	65	82	82
20. Total income A. ...	8,01	7,18	7,18	7,46	7,55	7,67	7,74	7,74	7,74	7,74
21. Total charges as above ...	7,99	7,16	7,13	7,42	7,51	7,63	7,31	7,09	6,92	6,92
22. Surplus B. (with 50 per cent on electric supply rates.)	2	2	41	54	60	63	105	1,27	1,44	1,44
Total income B. ...	8,01	7,18	7,54	7,96	8,11	8,26	8,36	8,36	8,36	8,36

APPENDIX No. 28.

Statement showing the incidence of taxation in the Municipalities in the different Provinces.

Province.	Municipalities in which the rates are the highest.	Rates.	Incidence of taxation in rest of the Municipalities in the Province.
		Rs. A. P.	
Madras ...	<div> <div>Ootacamund ...</div> <div>Kodaikanal ...</div> </div>	<div> <div>6 12 10</div> <div>6 1 1</div> </div>	<div> <div>The rates vary from annas 8 pies 4 to Rs. 4-9-6.</div> </div>
Bombay ...	<div> <div>Alandi ...</div> <div>Bandra ...</div> </div>	<div> <div>7 6 1</div> <div>5 4 3</div> </div>	<div> <div>The rates vary from annas 4 pie 1 to Rs. 4-13-3.</div> </div>
Bengal ...	<div> <div>Darjeeling ...</div> <div>Cossipore-Chitpur ...</div> </div>	<div> <div>8 6 9</div> <div>5 4 6</div> </div>	<div> <div>The rates vary from annas 6 pies 3 to Rs. 4-11-10.</div> </div>
United Provinces ...	<div> <div>Mussooree ...</div> <div>Naini Tal ...</div> </div>	<div> <div>10 1 3</div> <div>8 2 6</div> </div>	<div> <div>The rates vary from annas 5 pies 3 to Rs. 2-15-0.</div> </div>
Punjab ...	<div> <div>Simla ...</div> <div>Murree ...</div> <div>Rawalpindi ...</div> </div>	<div> <div>15 2 0</div> <div>4 13 3</div> <div>3 7 9</div> </div>	<div> <div>The rates vary from annas 12 pies 2 to Rs. 3-6-6.</div> </div>
Burma ...	<div> <div>Thaton ...</div> <div>Akyab ...</div> </div>	<div> <div>4 8 1</div> <div>4 5 11</div> </div>	<div> <div>The rates vary from annas 9 pies 9 to Rs. 3-14-0.</div> </div>
Bihar and Orissa ...	<div> <div>Kishenganj ...</div> <div>Sambalpur ...</div> </div>	<div> <div>2 8 8</div> <div>2 4 6</div> </div>	<div> <div>The rates vary from annas 6 pies 6 to Rs. 1-12-0.</div> </div>
Central Provinces ...	<div> <div>Harda ...</div> <div>Khandwa ...</div> </div>	<div> <div>4 14 8</div> <div>3 12 5</div> </div>	<div> <div>The rates vary from annas 3 pies 9 to Rs. 3-10-1.</div> </div>
Assam ...	<div> <div>Shillong ...</div> <div>Gauhati ...</div> </div>	<div> <div>3 7 7</div> <div>2 12 6</div> </div>	<div> <div>The rates vary from annas 5 pies 7 to Rs. 1-12-3.</div> </div>
North-West Frontier Province.	<div> <div>Abbotabad ...</div> <div>Edwardesabad ...</div> </div>	<div> <div>5 9 7</div> <div>4 15 5</div> </div>	<div> <div>The rates vary from Rs. 2-13-6 to Rs. 3-5-0.</div> </div>

APPENDIX 29.

Note on a modern Light Car.

The electric runabout for Simla would be evolved from and based on the type of small car now so popular at Home and which, known as the modern "Light Car," has proved a great success.

I was on the point of buying a light Car, when the war broke out and previously to deciding upon the best type to select, had made a most careful investigation into all the different types of medium and low priced cars on the market. The Car I selected was the Niagara Adler Carrette and my examination of this Car led me to select it as the best type of Light Car to be had: I placed the Singer Light Car perhaps second, followed closely by the Standard and Hillman.

When examining this Car it was my intention to ask special permission to try it in Simla with a view to illustrating the feasibility of this type of Car for use in Simla, after replacing the small High Speed 10 H. P. engine by a small High Speed motor of the same Horse Power, to be driven by an Edison nickel and iron storage battery charged by the Electricity Department at special rates not greater than $\frac{3}{4}$ of an anna per unit—the supply to be given at "off peak" hours, and looked upon similarly to the pumping load for which $\frac{1}{2}$ anna per unit is charged.

This type of Car would prove very popular in Simla and would be driven and controlled in almost exactly the same manner as any of the small Light Cars now on the market, so that no *special* training or knowledge would be required because it was electrical—in fact the control would be exactly similar but with the ignition and air control levers omitted (as in the case of the Niagara Adler which has an automatic carburetter and magneto retarding device) and also with one of the forward gears omitted. This type of car need *not* be described in detail since it is now so well known; suffice it to say that it would carry 2 people and a 3rd on the dicky seat, would be approximately 10 H. P. and 11 cwt. in weight and would be able to climb any hill in Simla over which the wheels could obtain a grip without skidding (the makers of the Niagara Adler Car guarantee this with their Petrol Car) which is possible on account of the extremely high gear ratio on the bottom gear— $1\frac{1}{8}$ —which for Simla can be increased to $2\frac{1}{2}$ if necessary. This would climb any hill; while the small overall dimensions of $10\frac{1}{2}' \times 5'$ (possibly reduceable to $10' \times 4\frac{1}{2}'$ or $4'$) would enable it to negotiate almost any turns, while others would automatically be widened. The wheel base and space generally would be almost exactly the same as an ordinary large rickshaw and four coolies.

In order to enable some idea of the machine to be readily obtained I attach a short General Specification of the Singer light Car as sold. This shows the general dimensions. I have cut out the items inapplicable to the Electric Car. The following points would require some special adaptation:—

The brakes would have to be specially strong and 4 supplied 1 on each wheel, well compensated and possibly a second set of external contracting brakes on the back wheels.

Possibly a special device would be necessary for putting on the brakes automatically when the speed exceeds 10 or 8 miles per hour, adjustable to act at 3 or 4 miles per hour on steep hills (the adjustment being made before starting down hill).

The battery would be located behind the body and under the Dicky seat, with special charging terminals and in a place from which it can be readily removed and replaced or else charged *in situ*. This would all be done on contract by the Simla Municipal Electricity Department.

I would not suggest any attempt, in the experimental car, towards employing regenerative control or any specialities of this type. My idea is that this same car would be used by the owners *as much in Delhi and Lahore* as in Simla: being just as useful in Delhi and Lahore as in Simla and as readily and

easily charged. Owners would bring their Car up to Simla in the spring and take it back with them to Delhi, etc., in the autumn. There is *no doubt* whatever in my opinion that in a few years' time, electrically propelled vehicles will entirely replace petrol vehicles for city use and are rapidly doing so in many of the larger American cities. Simla presents peculiarly suitable conditions for the successful adoption of such vehicles and there are overwhelming reasons for encouraging its adoption in Simla which are well known to the Municipal Committee. The Cars should all be required to pass a very strict inspection and test with *special* attention and stress laid on the following points :—

1. Safety of control and braking (any lady accustomed to drive her own Light Car would be able to drive it equally well when electrified and in Simla).

2. *Noise*.—The car should run absolutely *silently*.

3. *The hooter*.—Simla has a unique opportunity of setting an example to the whole world in the matter of the hooter nuisance which has been receiving so much attention at Home. All the Cars in Simla should be fitted with standard electrical horns tuned *to a musical note* or preferably to one of 3 musical notes forming the common chord of one scale. (This can be easily arranged and would prevent a vast amount of noise and nuisance on the roads).

A Standard Singer or other make of Light Car could easily be converted, or better still, made up by one of the best makers as an experimental Car for trial in Simla at no great expense probably about Rs. 2,000—4,000 and the sum so spent would be well invested.

If possible I could no doubt look into this question on behalf of the Municipal Committee when the war is over.

BOMBAY:

23rd October 1914.

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(Sd.) B. C. BATTYE,

Captain, R.E.

SPECIFICATION.

WHEELBASE	...	7ft. 6in. Overall length, 10ft. 6in.
TRACK	...	3ft. 6in. Overall width, 5ft. 0in.
LUBRICATION	...	Automatic.
TRANSMISSION	...	Leather-faced cone clutch enclosed type. Propeller shaft to gearbox axle.
GEARS	...	Three speeds and reverse, operated by gate change mechanism.
BACK AXLE	...	Live type. Unique design, giving silence on all speeds.
FRONT AXLE	...	H section drop forging.
STEERING	...	Irreversible worm and sector. The steering wheel is covered with exonite, and the control lever is fitted upon a stationary quadrant over steering wheel. A foot accelerator is also provided.
BRAKES	...	Expanding type on back wheels—hand and foot independent.
FRAME	...	Pressed steel of channel section, with front inswept to give greater lock to steering. Upswept back.
SPRINGS	...	Semi-elliptic, with supplementary springs to rear.
WHEELS	...	Four 700 by 80 Sankey steel detachable. Five Dunlop tyres.
BODY	...	Two-seater, trimmed best leather. Large boot at rear for tools, spares, etc.
MUDGUARDS	...	Dome-shape, with large side shields.
FOOTBOARD	...	Standard type, rubber covered.
SCREEN	...	Single adjustable Singer pattern.
HOOD	...	Standard pattern.
LAMPS	...	2 head, 2 side, 1 tail.
HORN	...	...
TOOL EQUIPMENT	...	Usual tools, including spanners, jack, pump, repair outfit, tyre levers, etc., etc.
FINISH	...	Painted Singer green (light colours, extra).

PRICE :—Complete with hood, screen, spare wheel and tyre, suite of 5 lamps, horn, outfit, tools, etc.

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